Leica TPS1100 Professional Series

User Manual

Version 2.2
English

Leica Geosystems

Congratulations on your purchase of a TPS1100 Professional Series instrument.

This manual contains important safety directions (*refer to chapter "Safety directions"*) as well as instructions for setting up the product and operating it.

Read carefully through the User Manual before you switch on the instrument.

The instrument model and the serial number of your product are indicated on the label in the battery compartment.
Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or authorized service workshop.

Type: _____ Serial number: _____

Software version: _____ Language: _____

The symbols used in this User Manual have the following meanings:

DANGER:

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and / or appreciable material, financial and environmental damage.

Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

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TPS1100 stands for **T**otal **S**tation **P**ositioning **S**ystem. The TPS1100 instruments are available as various models with differing classes of accuracy. New technologies have enabled the measuring sequence to be largely automated, bringing advantages such as shorter measuring times, simpler operation and more efficient use. Further elements in the basic equipment are described below.

The **R** versions have a laser with a visible red beam. The EDM can be switched between two operational modes: measurements with normal infrared or with the visible red laser respectively. With the red laser, reflectors are not required for measuring distances. With infrared, distances of up to seven kilometres can be measured.

All TPS1100 instruments are routinely supplied with a laser plummet located in the vertical axis. The TPS1100 can therefore be set up quickly and accurately over the ground point with the help of the red laser dot.

The A-versions have an automatic target recognition (**ATR**), which permits rapid, fatigue-free measuring. In ATR mode the fine-pointing is automatic. In LOCK mode an already-targeted point is tracked automatically.
For TPS1100 plus instruments an optional PowerSearch module is available which allows an automatic prism detection within a short period of time.

The **EGL** guide light is an optional accessory for assistance with targeting. It is located within the telescope and it flashes, so that the person carrying the reflector can place this in the line of sight of the instrument.
The RCS1100 remote control system is an additional option, which allows the remote control of all total stations. The instrument can be controlled either directly on the instrument or at the RCS1100. Especially the A-versions enable the surveyor to work alone.
The measurements can also be triggered, inspected and controlled from the target area.

Leica Geosystems offers **applications programs** for many different tasks in surveying. Just choose the software which best meets your needs.

Within the special **GeoBasic** programming environment, you can create your own application-specific programs for the TPS1100 instruments.

The **PC cards** familiar in the computer industry are also used as the medium for storing data in the TPS1100. The data structures are compatible with those in existing Leica Geosystems total stations.

Leica **Survey Office** is a PC-program package which supports the TPS1100 and RCS1100 instruments and which enables data to be exchanged between software and hardware components.

Validity

This manual applies to all TPS1100 Professional Series instruments.

Differences between the various models are clearly set out and assigned.

General text applies to all types.

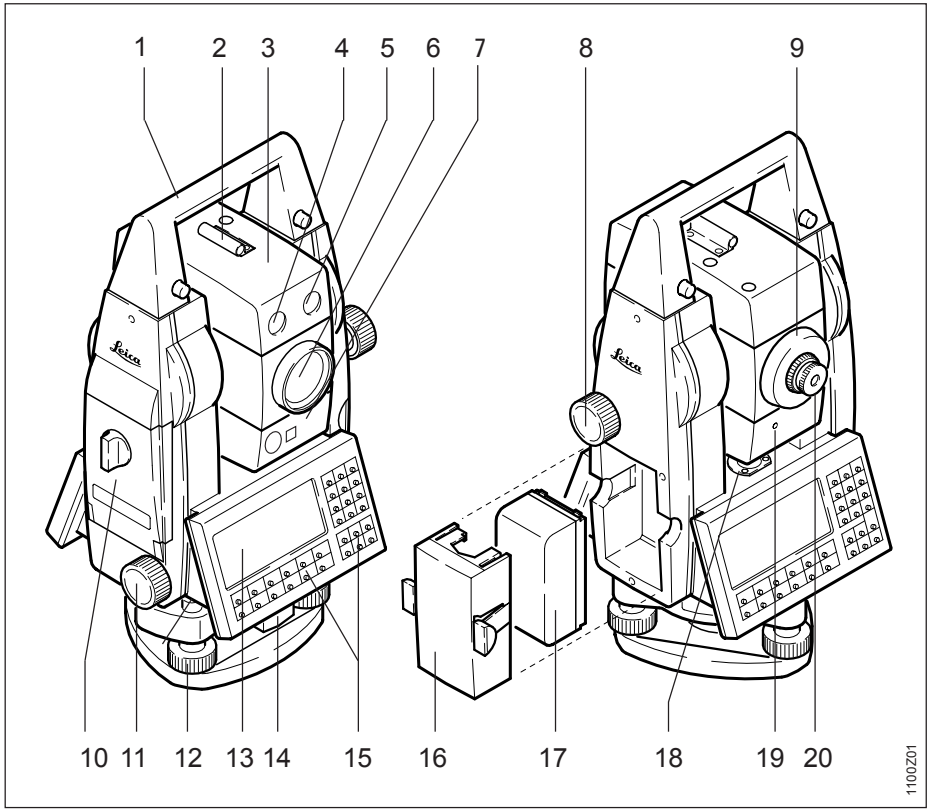
For purposes of pictorial illustration, we have selected a TCA model of the TPS1100 Professional Series with EGL options. The illustrations are valid for all models.

Documentation

Printed short instructions for the system and for the applications are available as well as the present user manual. The enclosed CD ROM contains the entire documentation in electronic form.

- **User manual:**
  This includes all directions for using the instrument and provides an overview of the system together with important instructions and safety directions.
- **System Field Manual:**
  This describes the functions of the system in standard use (in instrument case).
- **Application Programs Field Manual 1 + 2:**
  This describes the functions of the programs in standard use (in instrument case).
- **Application Programs Reference Manual:**
  All programs are described in detail.

Instrument descriptions



1 Carrying handle
2 Optical sight
3 Telescope with integrated EDM, ATR, EGL and PowerSearch
4 EGL flashing diode (yellow)
5 EGL flashing diode (red)
6 Coaxial optics for angle- and distance measurement; Exit port of visible laser beam (only R-model instruments)
7 PowerSearch sensor
8 Vertical drive screw
9 Focusing ring
10 PC-card housing
11 Horizontal drive screw
12 Footscrew (tribrach)
13 Display
14 Tribrach securing knob
15 Keyboard
16 Batteryholder
17 Battery
18 Bull's-eye bubble
19 Laser emission indicator lamp - only XR-instruments (yellow)
20 Interchangeable eyepiece

A laser distancer (EDM) is incorporated into the instruments of the new TPS1100 series.
In all versions, the distance can be determined by using an invisible infrared beam which emerges coaxially from the telescope objective.

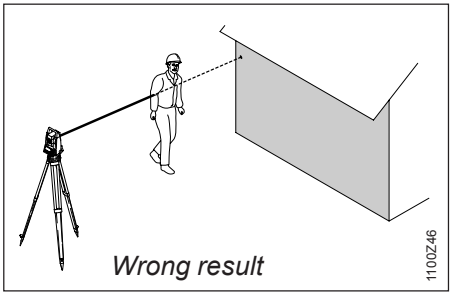
Very short distances may be measured reflectorless in Infrared-mode (e.g. to well reflecting targets like traffic signs). In this case the distances are corrected with the addition constant defined for the active reflector.

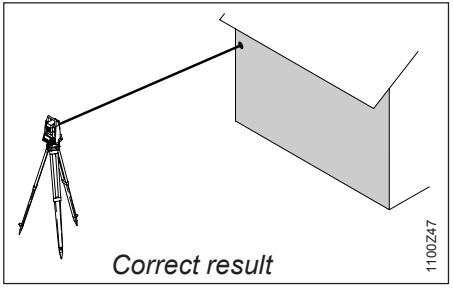
For applications **without reflector**, the TCR and TCRA version also use a **visible red laser beam** which emerges in the same manner. A special arrangement of the EDM, and appropriate arrangement of the beam paths, enable ranges of over five kilometres to be attained with standard prisms; miniprisms, 360° reflectors, and reflector tapes can also be used, and measurement is also possible without a reflector.

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment.

When measurements are being made using the Reflectorless Red Laser EDM, the results may be influenced by objects passing between the EDM and the intended target surface.
This will occur because reflectorless measurements are made to the first surface returning sufficient energy to allow the measurement to take place. For example, if the intended target surface is the surface of a road, but a vehicle passes between the EDM and the target surface as DIST or ALL is pressed, the measurement may be made to the side of the vehicle. The result will be the distance to the vehicle, not to the road surface.
If you are using the Long Range Red Laser EDM while measuring to a prism, and an object passes within 30 m of the EDM as DIST or ALL is pressed, the distance measurement may be similarly effected.

In practice, because the measuring time is very short, the surveyor can always find a way of avoiding critical situations.





The optional "Extended Range (XR)"-laser is a visible red laser with in-creased measurement range. The coaxial XR - laser makes it possible to measure distances over 170 m (560 ft) reflectorless and over 10 km (6.2 miles) to one prism (*refer to the chapter "Technical specifications"*).

The operation of an XR - instrument is equivalent to a conventional TPS with red laser. Please consider the following points when measuring with the XR - laser (RL & Long Range).

The objective lens should always be clean. Dirt on the lens (dust, fingerprints, ...) can lead to reduced accuracy.

Reflectorless

Be sure that the laser beam is not reflected by anything close to the line of sight (e.g. highly reflective objects).

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. In case of temporary obstruction (e.g. a passing vehicle) or heavy rain, fog or snow, the EDM may measure to the obstruction.

When measuring longer distances, any divergence of the red laser beam from the line of sight might lead to less accurate measurements. This is because the laser beam might not be reflected from the point at which the crosshairs are pointing.

Therefore, it is recommended to verify that the XR - laser is well collimated with the telescope line of sight (*refer to the chapter "Checking and adjusting"*). This should be done at regular intervals.

Do not measure with two instruments to the same target simultaneously.

Long Range to prisms

WARNING:
Due to laser safety regulations and measuring accuracy, using the Long Range Program is only allowed to prisms that are more than 1000 m (3300 ft) away.

Whenever possible accurate measurements to prisms should be made with the standard program (IR).

Long Range to reflector tape

The Long Range Program can also measure to reflector tape. To guarantee the accuracy the laser beam must be perpendicular to the reflector tape and the XR - laser must be well adjusted (*refer to the chapter "Checking and adjusting"*).

TCA and TCRA instruments are motorized and equipped with Automatic Target Recognition (ATR) coaxially in the telescope. The guide light (EGL), mounted on the telescope, is optional.

ATR mode

These instruments permit automatic angle and distance measurements to normal prisms and reduce the tedium of precise visual sighting to prisms. The prism is sighted with the optical sight only. Initiating a distance measurement will turn the instrument with the help of the motors to sight the prism-centre automatically. The angles V and Hz are measured to the centre of the prism completion of the distance measurement.

As with all other instrument errors, the collimation error of the automatic target recognition (ATR) must be redetermined periodically (*Refer to chapter "Checking and Adjusting"*).

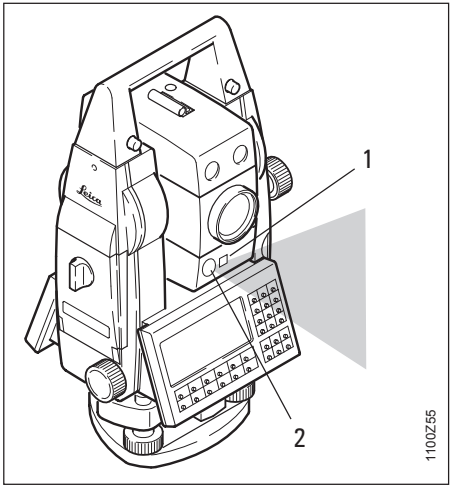
LOCK mode

Lock mode will enable TCA instruments to follow a moving prism. Distances can be measured whenever the prism stops for a short time ("Stop and Go mode").

If the assistant changes the location too quickly, the target may be lost. Make sure that the speed does not exceed the figure given in the technical data.

Quick Prism Search with PowerSearch

The PowerSearch sensor consists of a transmitter (1) and a receiver (2). Both are installed in the lower part of the telescope.



When PowerSearch is activated, the instrument starts to rotate around its standing axis.The transmitter emits a vertical laser swath.

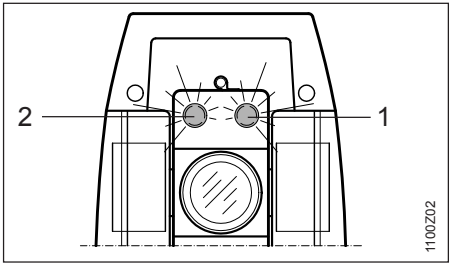
If the laser swath detects a prism, the reflection is detected by the receiver and the rotation of the instrument is stopped. Afterwards a fine aiming in vertical direction is performed by the ATR.

PowerSearch can be started at any time by pressing the PowerSearch function key (PS) in the menu PROG.

If RCS mode is activated, then PowerSearch can be switched on during an ATR prism search.

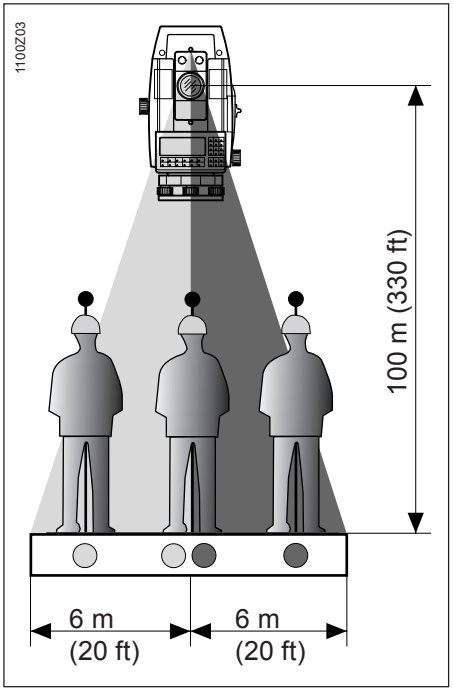
Working range:	5-200 m
Swath divergence Hz:	0.025 gon
Swath divergence V:	±20 gon

The optionally available Guide Light EGL consists of two coloured flashing lights in the telescope of the total station.



1 Flashing red diode
2 Flashing yellow diode

All TPS1100 instruments can be equipped with this Guide Light. The person at the prism can be guided by the flashing lights directly to the line of sight. It becomes much easier to set out points.



At a target distance of 100 metres (330 ft) a red/yellow flashing cone of light with a width of 6m (20 ft) is formed on each side. As a result, guiding to the line of sight of the instrument is much easier and faster.

Between the two cones of light a sector about 30mm wide is created. Within this sector both colours are flashing simultaneously. In this case the prism is already right in the line of sight.

Operating range:
5 - 150 m (15 -500 ft)
Divergence:
10 m (33ft) at 100m (330 ft)

The RCS option (Remote Controlled Surveying) permits all models to be controlled from the target area. Especially qualified for this purpose are the TCA and TCRA instruments.

RCS 1100

Combined operation, partly at the TPS1100 and partly at the prism, is also possible.
As a result, surveys can be performed solo. It is also possible to monitor the operation on the RCS 1100 and / or to enter the coding on the RCS 1100.

All functions of the TPS1100, including the applications programs, are available on the RCS 1100. The display and the use of the keys are as for the TPS1100.

For further information, refer to the RCS1100 user manual.

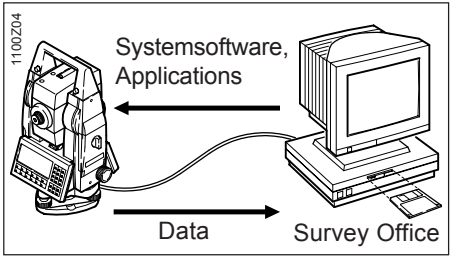
All of TPS 1100 models use the same software architecture and the same concept for data storage and data flow.

Software architecture

The software of the TPS1100 can be divided into two groups:

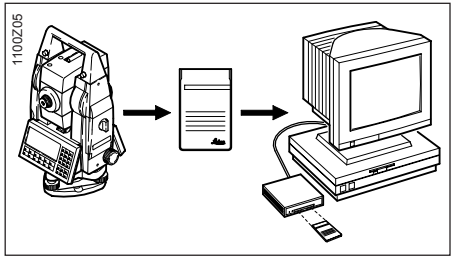
- The **system software**, which covers the basic functions
- The **applications software**, which supports survey- specific applications and procedures.

The system software forms a coherent unit, whereas the applications software can be compiled in accordance with the individual requirements of the user. Using the Leica **Survey Office** software provided, both the system software and the applications software can be loaded across the serial interface by the user, who is in a position to install improved software versions.



The software permits up to three languages to remain stored simultaneously and one of them to be selected. The range of language versions available is constantly being expanded. If you need a particular language version, please ask your agency about its availability.

Storage concept and data flow



Survey data is generally stored on a SRAM or ATA flash card corresponding to PCMCIA standards (referred to here as a PC card). The data are stored in MS-DOS file format. Data is exchanged with a PC through either a PCMCIA drive on that PC, or an OMNI drive (optional), or the serial interface (cable link between instrument and PC).
The Leica Survey Office software supplied with the instrument includes a program for transferring data across the serial interface.

Instead of using the PC card, the data can be output in GSI format at the serial data interface.

When data is transferred across the serial interface for storage in an external PC, no data from the applications is output in the report file. Fixed-point coordinates can be read only from the PC card.

GeoBasic

The GeoBasic development environment permits the professional development of additional applications for the TPS1100.

The Leica Survey Office software includes a series of help programs which support you in your work with the TPS1100 total station.

Installing in the PC
The installation program for Leica Survey Office is located on the TPS1100 CD-ROM supplied with the present handbook. Please note that Survey Office can only be installed on the following operating systems:
MS Windows 95/98/Me and
MS Windows NT4.0/2000/XP.

To install the program, first call up the program "**setup.exe**" from the directory **\SurveyOffice\English\Disk1** on the CD-ROM, and carry out the instructions given. For further information, refer to the handbook or to the on-line help provided by your operating system.

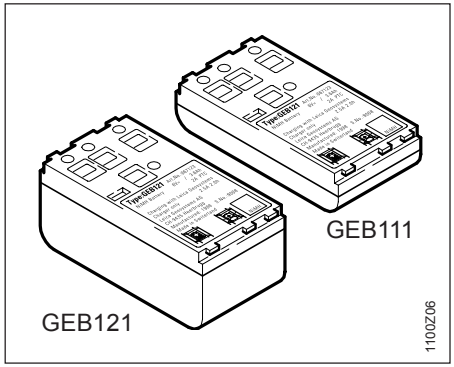
Range of programs

After the installation is complete, the following programs are available:

- **Data Exchange Manager:**
  Exchange of data between the instrument and the PC.
- **Codelists Manager:**
  Creates code lists.
- **Software Upload:**
  Loading and deleting systems software, applications programs, systems texts and applications texts.
- **Coordinate Editor:**
  Editing of coordinates.

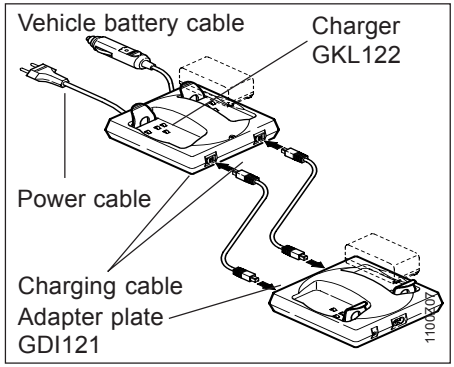
Optionally, additional programs can be installed.

For additional information about Leica Survey Office, please refer to the comprehensive on-line help.

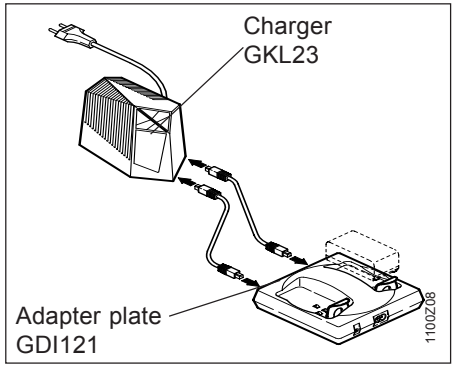


Your Leica Geosystems instrument is powered by rechargeable battery modules. The Pro battery (GEB121) is recommended for the TPS1100 Professional Series. The basic battery (GEB111) is an optional alternative.

Use only the Leica Geosystems batteries, chargers and accessories, or accessories recommended by Leica Geosystems.



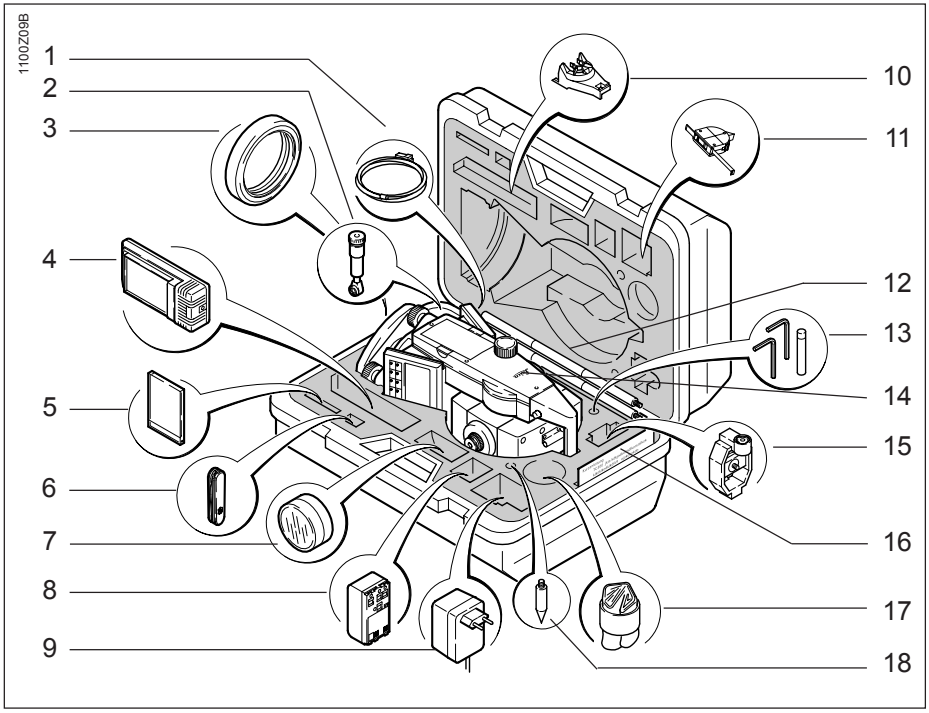
The Professional charger (GKL122) will charge up to four batteries, either from a 230V or 115V power source using a power plug or from the 12V or 24V source provided by the cigarette lighter in a vehicle. At any one time, either two Pro / Basic batteries can be charged or, by using the adapter plate (GDI121), four Pro / Basic batteries.



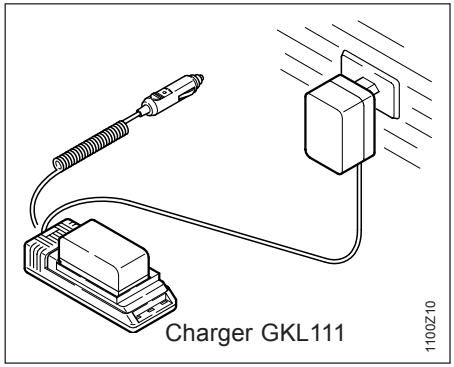
The adapter plate GDI121 can be connected to the Pro charger (GKL122) or to the GKL23 charger, and enables two Pro / Basic batteries to be charged simultaneously.

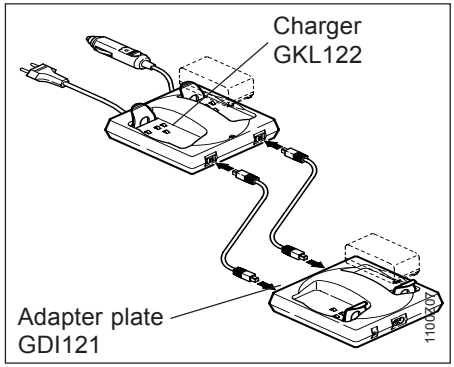
Unpacking

Take the instrument out of the transport container and check that it is complete:



1 PC cable (optional)
2 Eyepiece for steep sights / Zenith eyepiece (optional)
3 Counterweight for eyepiece for steep sights (optional)
4 Charger GKL111 (optional)
5 PC card (optional)
6 Pocket knife (optional)
7 Auxiliary lens (optional)
8 Spare battery (optional)
9 Power plug for GKL111 (optional)
10 Spacing bracket (optional)
11 Height meter (optional)
12 Mini prism rod (optional)
13 Tool set, comprising 2 adjusting pins, 1 Allen key each for adjusting bull's-eye bubble and EDM.
14 Instrument
15 Mini prism + holder (optional)
16 Short instructions/ target plate (only for reflectorless measuring instruments)
17 Protective cover, sunshade
18 Tip for mini prism (optional)



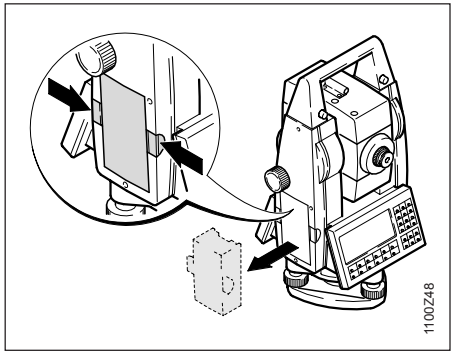


The battery chargers GKL111 or GKL122 are used to charge the batteries. Please refer to the corresponding battery charger user manual for more information.

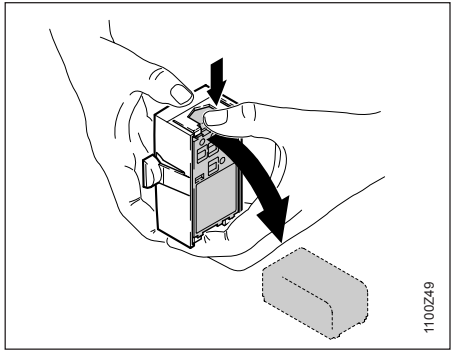
WARNING:

The battery chargers are intended for indoor use only. Use the battery charger in a dry room only, never outdoors. Charge batteries in an ambient temperature between 0°C and 35°C (32°F to 95°F). We recommend a temperature of 0°C to +20°C (32°F to 68°F) for storing the batteries.

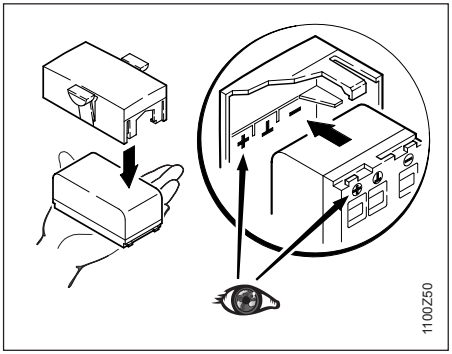
To attain full battery capacitance, it is essential to subject new GEB111 / GEB121 batteries to between three and five complete charge/discharge cycles.



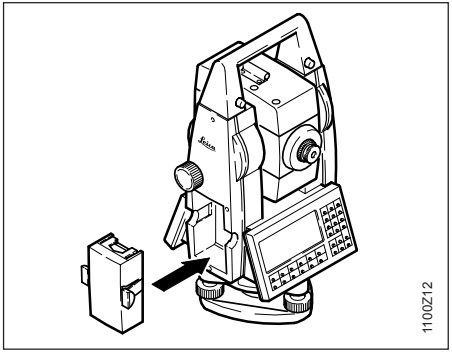
1. Remove battery holder.



2. Remove battery and replace.



3. Insert battery into battery holder.



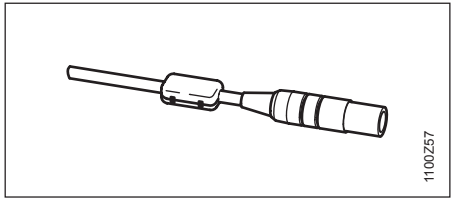
4. Insert battery holder into instrument.

Insert battery correctly (note pole markings on the inside of the battery cover). Check and insert battery holder true to side into the housing.

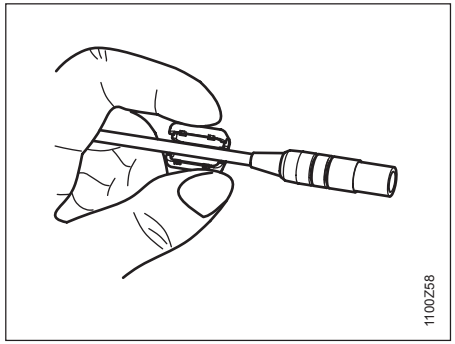
External power supply for total station

To meet the conditions stipulated for electromagnetic acceptability when powering the TPS1100 from an external source, the supply cable used must be equipped with a ferrite core.

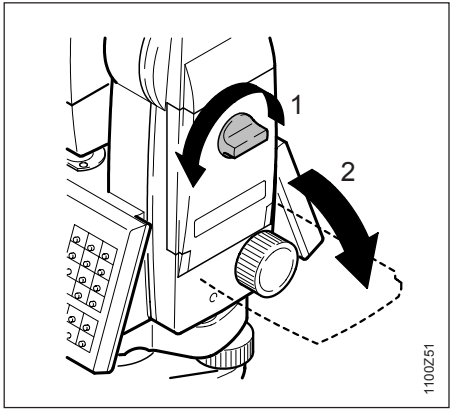
The Lemo plug with the ferrite core always has to be attached at the instrument side.



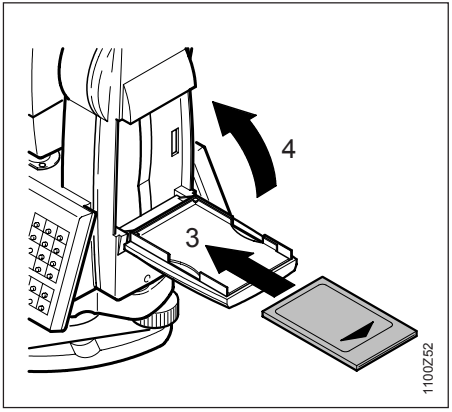
The cables supplied along with your instrument include a ferrite core as standard.
If you are using older cables without ferrite core, it's necessary to attach ferrite cores to the cable.
If you need additional ferrite cores, please contact your local Leica Geosystems agency. The spare-part number of the ferrite core is 703 707.



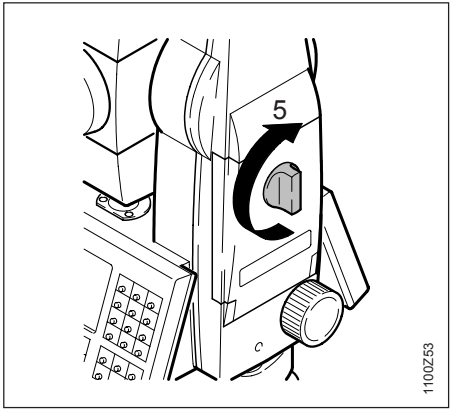
For assembling open up one ferrite core and clip it around the supply cable, about 2cm away from the Lemo plug, before using the supply cable for the first time together with a TPS1100 instrument.



1. Open PC-card housing.

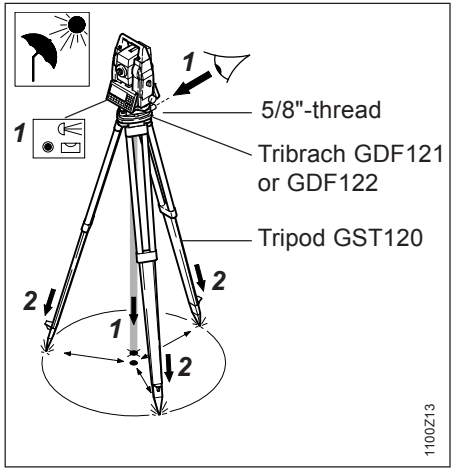


2. Insert PC-card with TPS- arrow symbol facing up.



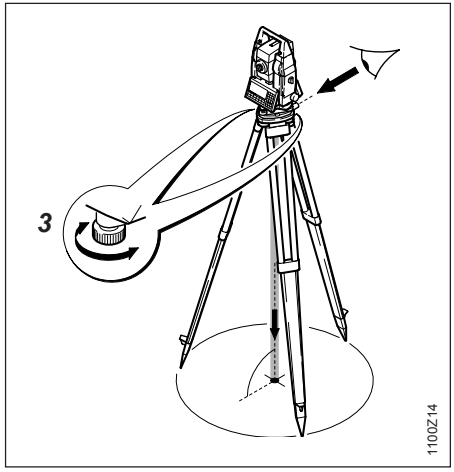
3. Closing PC-card housing.

When closing the PC-card housing the connector must face upwards!!



1. Target the ground point or activate the laser plummet.
2. Set up the GST20, centring it as well as possible.

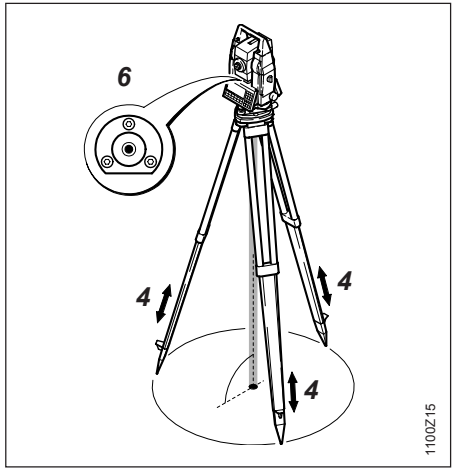
The laser plummet is built into the vertical axis of the TPS1100 instruments. Projecting a red dot on to the ground makes it appreciably easier to centre the instrument.



3. Using the footscrews of the tribrach, centre the plummet to the ground point.

4. Move the legs of the tripod to centre the bull's-eye bubble.

The laser plummet cannot be used in conjunction with a tribrach which already has an optical plummet.

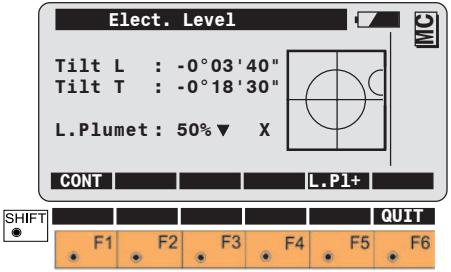


5. Level-up precisely, using the electronic bubble (*see the chapter "Levelling-up with the electronic bubble"*).

6. Centre precisely by shifting the tribrach on the tripod plate.

Repeat steps 5 and 6 until the required accuracy is reached.

SHIFT Graphical and numerical display of the longitudinal and transverse tilt of the instrument's vertical axis.
The current settings of the laser plummet are indicated numerically as a percentage.

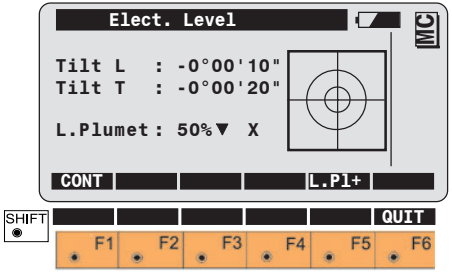


F5 Switches the laser plummet on or off.

Varies the intensity of the laser dot.

Using the footscrews, the instrument can be levelled-up without having to turn it through 90° (100 gon) or 180° (200 gon).
In the display which is closest to the bull's-eye bubble, the movement of the small circle runs parallel to the movement of the bubble in the alidade. The other display shows the movement in the opposite direction.

When the bubble is centred, the TPS1100 has been perfectly levelled up.



Electronically

All instruments basically have inherent mechanical defects which can affect the measurement of angles. The electronic angle-measuring system of the TPS1100 routinely corrects the mechanical instrument errors listed below; the vertical angles relate to the plumb line and the horizontal measurements are corrected for line-of-sight error, for tilting-axis error and for vertical-axis tilt:

- l, t Compensator index error
- i Vertical-index error
- c Line-of-sight error
- a Tilting-axis error
- ATR ATR zero-point error (only for TCA and TCRA versions)

The instrument errors listed on the left can change over time and with temperature.

They should, therefore, be redetermined in the order shown below:

- before the first use
- before each precision survey
- after long periods of transport
- after long periods of work
- if the temperature alters by more than 20°C

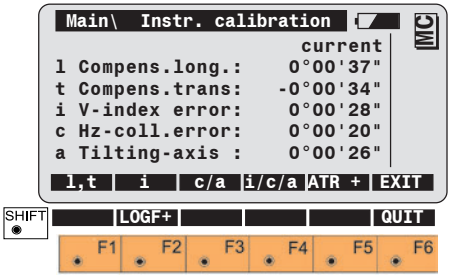
Before determining the instrument errors, level-up the instrument using the electronic bubble. The instrument should be secure and firm, and should be protected from direct sunlight in order to avoid thermal warming on one side only.

Take note that the procedure for determining the relevant instrument error has to be followed precisely and carefully.

The determination of the instrument errors can be started in any telescope face.

Immediately after the first measurement has been completed, motorized instruments change automatically to the second face, after which the user merely needs to carry out the fine pointing.

Activating the "Instrument calibration" function.



F1 Determines the compensator index error. Simultaneous adjustment of the electronic bubble.

F2 Determines the index error for the vertical circle (V-index error).

F3 Defines line-of-sight errors and, if required, tilting-axis errors.

F4 Joint determination of the V-index errors, line-of-sight errors and, if required, tilting-axis errors.

F5 Determines the collimation error of the ATR (TCA and TCRA versions only).

SHIFT F2 Enables the calibration Log-file (*see next page*).

The instrument errors reported are displayed in the sense of an error. When measurements are being corrected, they are used in the sense of corrections and have the opposite sign to the error.

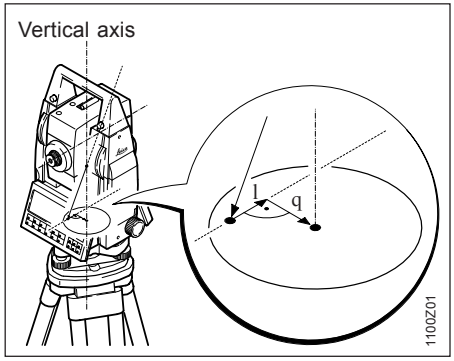
Calibration Log-File

If the Log-File is enabled [LOGF+], the measurements and results of the calibration are stored in an ASCII-file. This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

New data is always appended to the calibration Log-file.

```
TPS1100 - Instrument Calibration
Instrument      : TCRA1102plusSerial 619216


Compensator Index Error l,t
Date/Time       :     03/04/2000     15:43

Old values      :     l=    0.0000g            t=          0.0000g
Measurements
                      L=    -0.0126g           T=          0.0298g
                      L=    0.0368g            T=          0.0164g

New values      :     l=    0.0010g            t=          0.0023g


Vertical Index Error i
Date/Time       :     03/04/2000     15:45

Old value       :     i=     0.0000g
Measurements
                      Hz=  377.0597 g          V=        104.2828 g
                      Hz=  177.0562 g          V=        295.7176 g

New value       :     i=    0.0001g
```

Example of a Calibration Log-file (here compensator and vertical index errors)

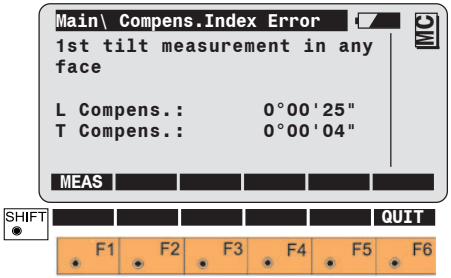


The determination of the index error for the longitudinal and transverse axes of the compensator (l, t) corresponds to the determination of the centre of the bubble used in the level.

The instrument should be set up away from warmth coming from one side some time before the calibration so that it can adjust to the ambient temperature.The index error for the longitudinal and transverse axes is determined at the factory and adjusted to zero before delivery.

F1 Activate the calibration procedure. (*Refer to display on page 30)*

The longitudinal and transverse axes (l, t) are displayed afterwards in the following dialog.



F1 Initiate the measurement of the longitudinal and transverse tilt (l, t).

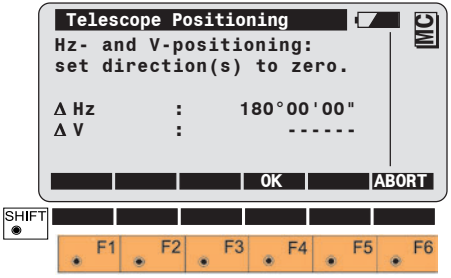
If the tilt cannot be measured, e.g. due to an unstable instrument, the error message **ERROR: 557** is displayed and the following keys are defined:

F5 Repeat measurement.

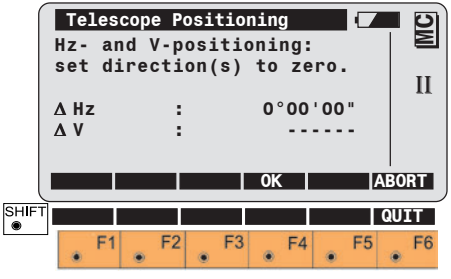
F6 Abort measurement.

Non-motorized instruments perform the second measurement after the alidade of the instrument has been turned 180° (200 gon), with an accuracy of ±4° 30' (±5 gon).
After the initial measurement has been started by pressing the key F1, motorized instruments will automatically complete the determination of l and t without any other assistance.
The following dialog is displayed after completing the first tilt measurement with non-motorized instruments.

After the first measurement of tilt, the menu for non-motorized instruments is the following:



Turn the instrument through 180° (200 gon) so that ΔHz = 0° 00' 00" (0.0000 gon).



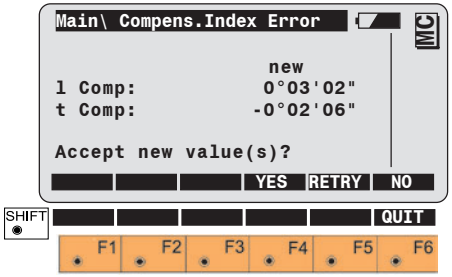
If the differences between the horizontal and vertical angles lie within ±4° 30' (±5 gon), the display can be quitted with F4.

The user is made aware by an acoustic signal that the F4 -key is redefined as "OK".

F4 Activates the second tilt measurement.

F6 Terminates the determination of the compensator indexes.

The following dialog shows the two newly-determined values for the longitudinal and transverse compensator-index errors.

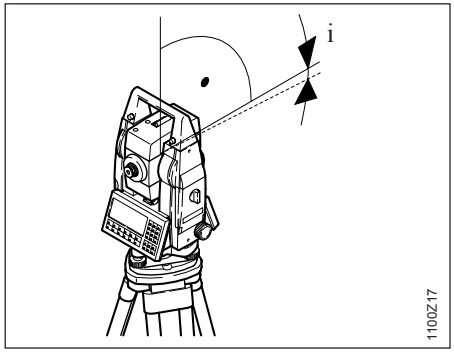


F4 Stores the new values.

F5 Repeats the complete calibration procedure.

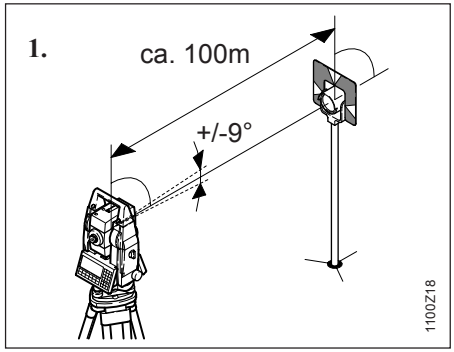
F6 Leaves the previous values unchanged.

If the values for the index errors **(l, t)** exceed 5' 24" (0.1 gon), the complete calibration procedure repeat, but first check that the instrument is correctly levelled and is free of vibration. If these values are exceeded repeatedly, please notify service.



The V-index error is the zero-point error of the vertical encoding circle in relation to the vertical axis of the instrument.
The V-index error is set to "0.00" before delivery.
All vertical angles are corrected with the V-index error.

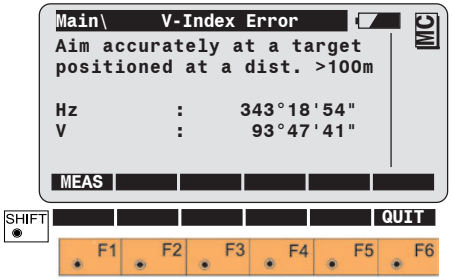
The instrument should have adapted to the ambient temperature and should be protected against warming from one side.



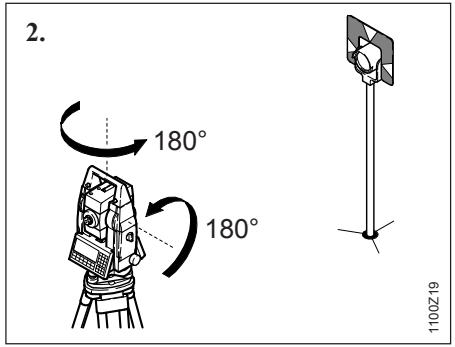
To determine the V-index error, aim the telescope at a target about 100m distant. The target must be positioned within ±9° (±10 gon) of the horizontal plane.

F2 Activate the calibration procedure (*Refer to display on page 30*). The two-axis compensator is turned off automatically when determining the V-index error.

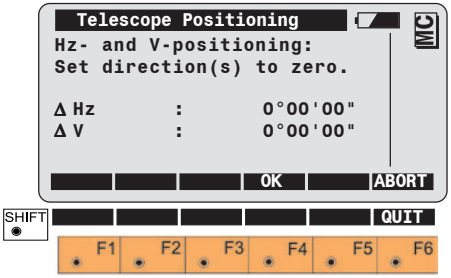
This fact is shown by the symbol.



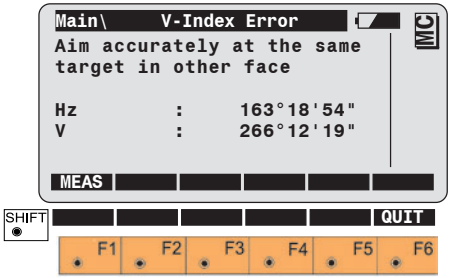
F1 Starts the measurement for the vertical circle.
Afterwards, the display shows a message asking for the telescope to be turned to the other face.



If the differences between the horizontal and vertical angles do not exceed ±27' (±0.5 gon), the display shows that the instrument is ready to measure. The user is made aware by an acoustic signal that the F4 key is redefined as 'OK'.



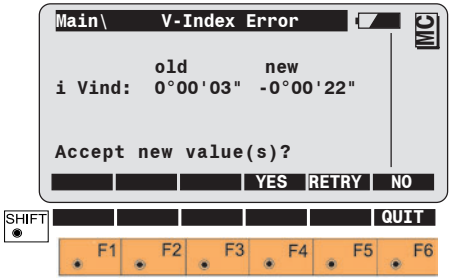
F4 Confirms the readiness to measure and changes the display.



Sight the target accurately again.

F1 Starts the second measurement.

After the measurements are complete, the older and newly-determined V-index errors are displayed.



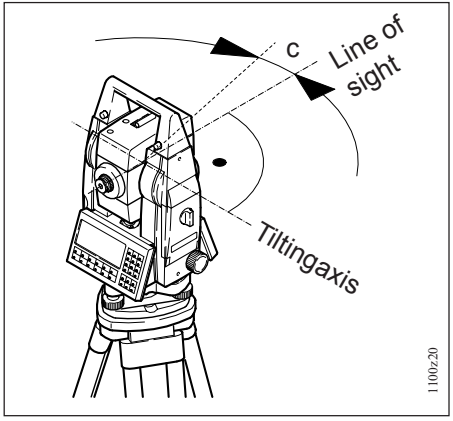
F4 Stores the new values.

F5 Repeats the complete V-index error determination procedure.

F6 Leaves the old values unchanged.

If the value of the V-index error (**i**) exceeds 54' (1 gon) you should repeat the measurement procedure. If this value is exceeded repeatedly, please contact service.

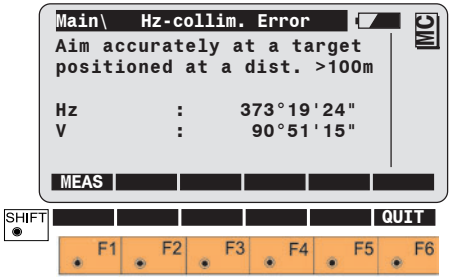
The line-of-sight error **c** is the divergence of the line of sight from a line perpendicular to the tilting axis. The line-of-sight error is adjusted and reduced to "0.00" before delivery from the factory.
Horizontal angles are only corrected by this line of sight error when the correction is turned "**ON**" (setting in accordance with *section "Deactivating the instrument-error correction"*).



To determine the line-of-sight error, aim the telescope at a target about 100m distant. The target must lie within ±9° (±10 gon) of the horizontal plane.
The procedure is analogous to that of determining the V-index error.

F3 Activates the calibration procedure. (*Refer to display on page 30*).

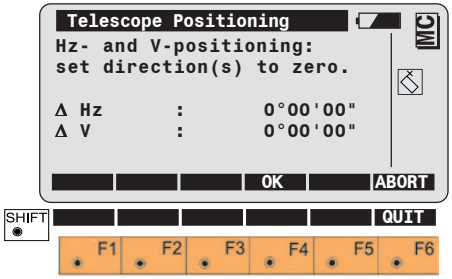
The two-axis compensator is turned off automatically when determining the line-of-sight error.
This fact is shown by the symbol.



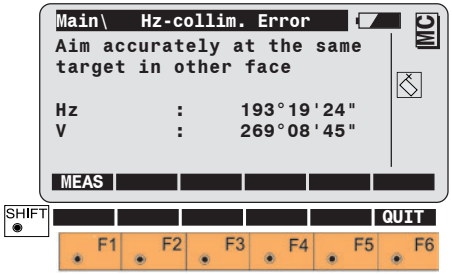
F1 Perform the measurement.

Afterwards, a message in the display prompts you to change telescope face.

If the differences between the horizontal and vertical angles do not exceed ±27' (±0.5 gon), the display shows that the instrument is ready to measure. The user is made aware by an acoustic signal that the F4 key is redefined as "OK".



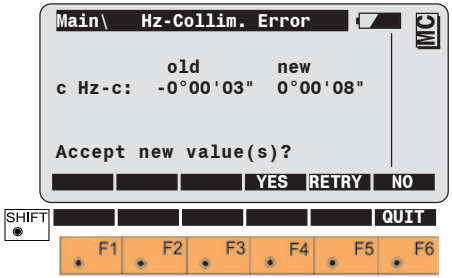
F4 Confirms readiness for measurement and goes to the measuring menu.



Sight the target accurately.

F1 Perform the second measurement.

After successful completion of the second measurement, the older and the newly-determined line-of-sight errors are displayed.



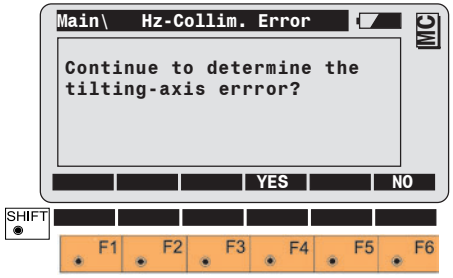
F4 Stores the new values.

F5 Repeats the complete line-of-sight error determination procedure.

F6 Leaves the old values unchanged.

If the value of the line-of-sight error (**c**) exceeds 5' 24" (0.1 gon), the collimation error is to be redetermined. If the limit is repeatedly exceeded, please notify service.

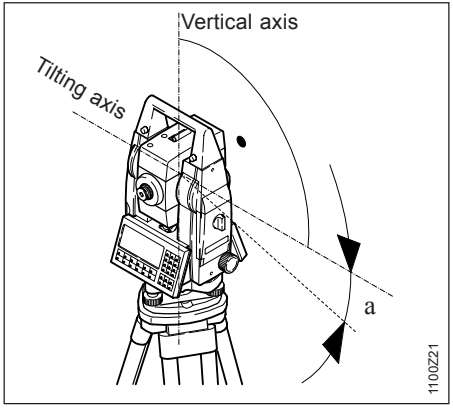
When the new line-of-sight error has been confirmed, the tilting-axis error can be determined.



F4 Confirms that the tilting-axis error should also be determined.

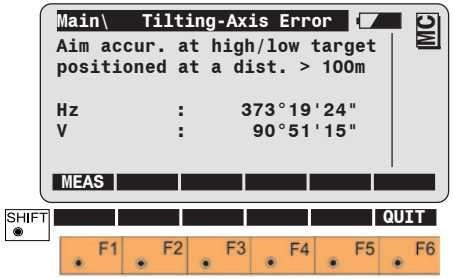
F6 Ends the function and returns to the calibration dialog.

The tilting-axis error a is the deviation of the tilting axis from a line perpendicular to the vertical axis.
The tilting-axis error is adjusted to "0.00" before delivery.
The horizontal angles are only corrected by the tilting axis error when the Hz-correction is turned "**ON**" (setting in accordance with *section "Deactivating the instrument-error correction"*).



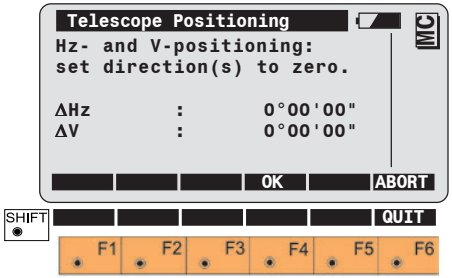
To determine the tilting-axis error, aim the telescope at a target about 100m distant. The target must be positioned at least ±27° (±30 gon) above or beneath the horizontal plane. The two-axis compensator is turned off automatically during determination of the tilting-axis error.

This fact is shown by the symbol.

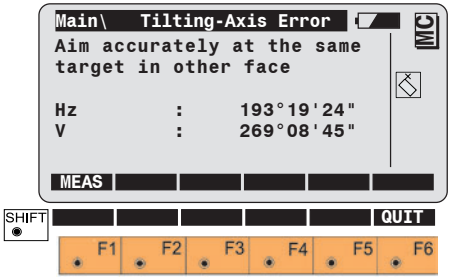


Start measurement. Afterwards, a message in the display prompts the user to change telescope face.

If the differences between the horizontal and vertical angles do not exceed ±27' (±0.5 gon), the display shows that it is ready to measure. The user is made aware by an acoustic signal that the key is redefined as "**OK**".



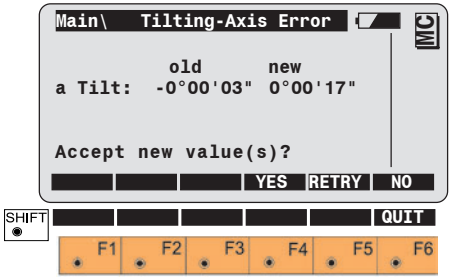
F4 Confirms readiness to measure and the display changes as follows.



Sight the target accurately.

F1 Performs the second measurement of the horizontal angle.

After the second measurement has been completed, the old and newly-determined tilting-axis errors (a) are displayed.



F4 Stores the new values.

F5 Repeats the complete tilting-axis error determination procedure.

F6 Leaves the old values unchanged.

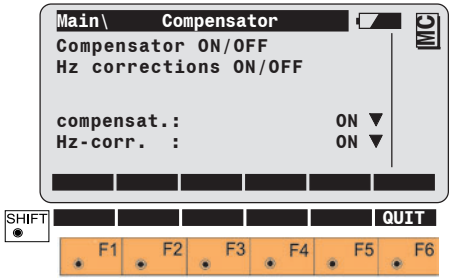
If the value of the tilting axis error (**a**) exceeds 5' 24" (0.1 gon), the measurements are to be repeated. If this happens often, please notify service.

By using the key F4 in the *display on page 30*, it is possible to determine the errors for vertical index, line of sight and tilting axis (**i**/**c**/**k**) with a single operation.

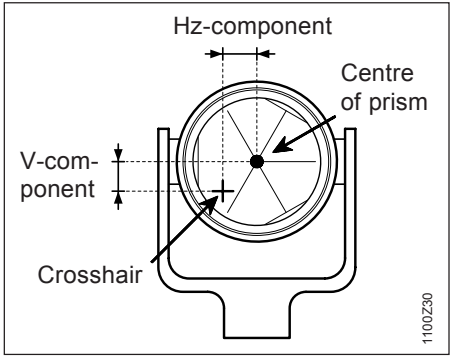
The V-index and line-of-sight errors can be determined using a common target which does not lie more than ± 9° (± 10 gon) away from the horizontal plane. The determination of the tilting-axis error requires a target which lies at least ± 27° (± 30 gon) above or beneath the horizontal plane.

For exact procedural details, please refer to the previous chapters.

Also the mechanical instrument-error correction can be deactivated if the need is to display and record only raw data. To deactivate, set the compensator correction and the horizontal-circle correction to OFF, i.e. the vertical angles relate to the vertical axis and the horizontal corrections are not taken into account.

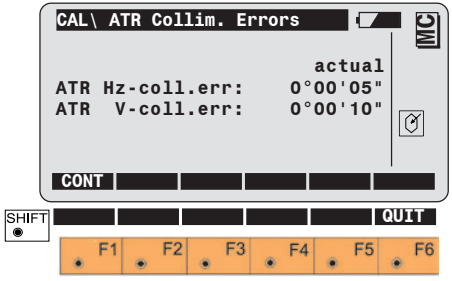


(Available for TCA and TCRA versions only)
The ATR collimation error is the combined horizontal and vertical angular divergence of the line of sight from the axis of the CCD camera. The collimation procedure includes, optionally, the determination of the line-of-sight error and the vertical-index error.
The correction for the ATR collimation errors is always applied regardless of the "ON/OFF" status of the Hz-correction setting. (*See section "Deactivating the instrument-error correction"*).



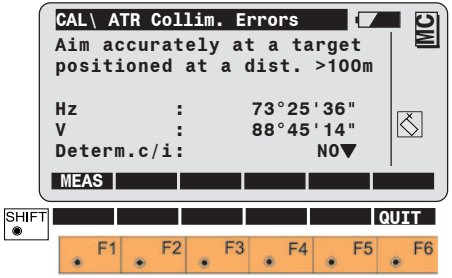
To define the ATR collimation error, a prism must be accurately targeted at a distance of about 100 m. The target must lie within ±9° (±10 gon) of the horizontal plane. The procedure is analogous to that of determining the V-index error.

F5 Activates the calibration procedure (*Refer to display on page 30*). The ATR target recognition is automatically switched on. This fact is shown by the symbol. The display shows the current horizontal and vertical ATR collimation errors.



F1 Starts the calibration.

The two-axis compensator is turned off automatically when determining the ATR collimation error.
This fact is shown by the symbol.



Sight the prism accurately with the crosshair.

F1 Starts the measuring procedure.

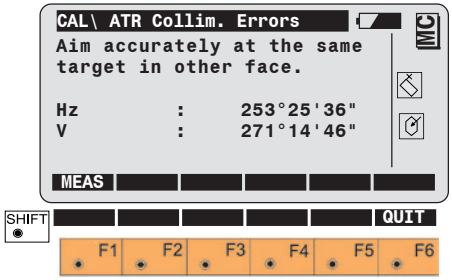
/ Toggles between simple and combined error determination.

YES = Simultaneous determination of ATR-collimation error, line-of-sight error and vertical-index error

NO = Only determination of ATR-collimation

It is advisable to determine the ATR-collimation error, the line-of-sight error and the vertical-index error at the same time.

Changes face automatically directly after completing the initial measurement.

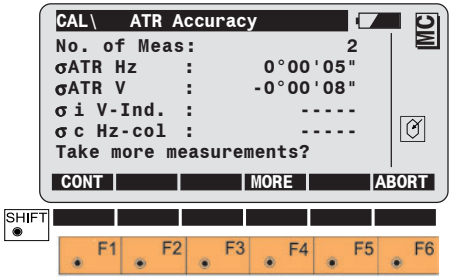


Sight the prism accurately with the crosshair.

F1 Performs the second-face measurement of the collimation errors.

If the differences between the horizontal and vertical angles exceed ±27' (±0.5 gon), the display gives an error message. The user is made aware of this by an acoustic signal and the F4 key is redefined as "OK".
The measurement procedure can be repeated.

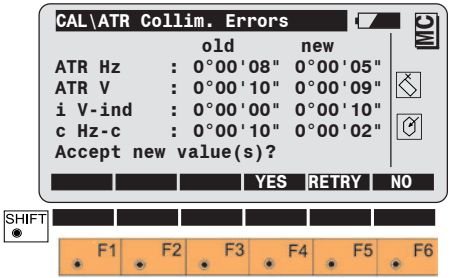
When the second measurement has been taken, the accuracy of ATR and, if previously selected, the accuracy of the index and the line-of-sight errors are displayed.



F1 No further repeat measurements are required. The old and the newly-defined ATR-collimation errors become optional, and are displayed together with the line-of-sight errors (c) and the V-index errors (i).

F4 The calibration can be repeated as often as necessary until the required level of accuracy is obtained. The result is the mean of all the measurements taken. It is recommended that at least two measuring sequences be carried out.

F6 The calibration process is interrupted. The old values will be left intact.



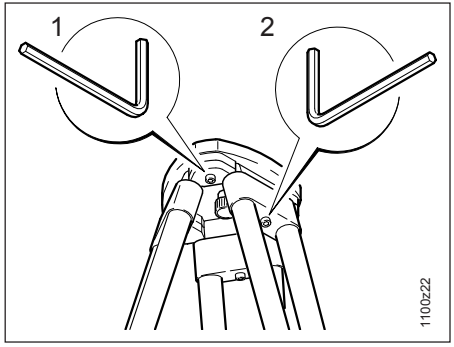
F4 Stores the new values.

F5 Repeats the ATR1 error determination procedure.

F6 Leaves the old values unchanged.

If the value of the ATR horizontal and vertical collimation errors exceeds 2' 42" (0.05 gon), repeat the measurement procedure.
Similarly, if the value of the V-index error (i) exceeds 54' (1 gon) or if the value of the line-of-sight error (c) exceeds 5' 24" (0.1 gon) , the measurements are to be repeated.
If these values are often exceeded, please contact service.

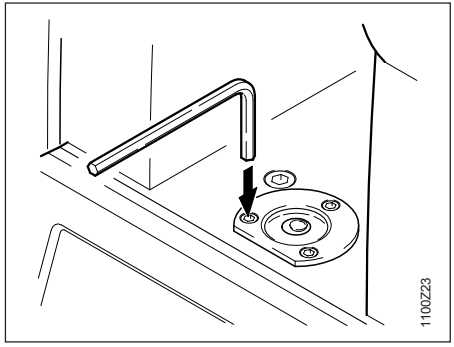
Tripod



The connections between timber and metal must always be firm and tight.

- Moderately tighten the Allen screws (2).
- Tighten articulated joints (1) just enough to keep the tripod legs open when you lift the tripod off the ground.

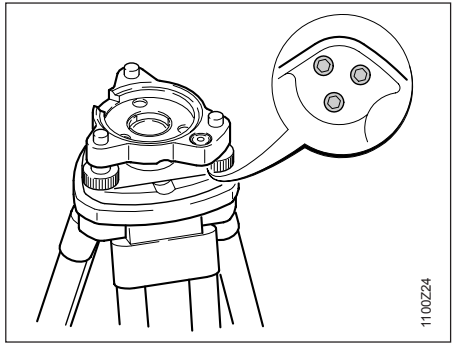
Bull's eye bubble on instrument



Level-up the instrument in advance with the electronic bubble. The bubble must be centred. If it extends beyond the circle, use the adjusting pin supplied to centre it with the adjustment screws.

After adjustment no screw shall be loose.

Bull's eye bubble on the tribrach

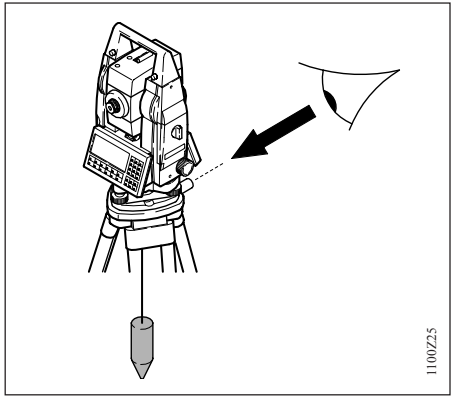


Level the instrument and then remove it from the tribrach. If the bubble is not centred, adjust it using the adjusting pin in conjunction with the two cross-headed adjustment screws (GDF121 bzw. GDF122).
Turning the adjustment screws:

- to the left: the bubble approaches the screw
- to the right: the bubble goes in the other direction.

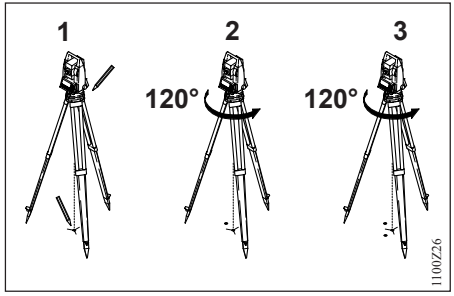
After adjustment no screw shall be loose.

Checking by plumb-bob:



Set-up and level the instrument on the tripod. Check the centring sleeve for eccentricity by hanging it in place in various positions, then mark the ground point. Remove the plumb-bob. Check that the crosshairs of the optical plummet intersect at the ground point. The accuracy achievable is about 1mm.

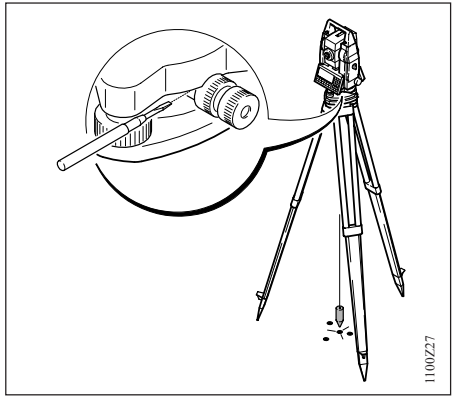
Checking by turning the tribrach



1. Level-up the instrument using the electronic bubble. Mark the ground point. Using a soft, well-sharpened pencil, mark the outline of the tribrach on the tripod plate.
2. Turn the tribrach 120 ° and level-up the instrument, fit it into the outline, and again mark the ground point.
3. Repeat again in the third position.

If the three points do not coincide, adjust the crosshairs to the centre of the triangle formed by the three ground points.

Adjustment



Use a screwdriver to turn the two set screws alternately by the same small amount in order to centre the crosshairs on the ground point marked.

Inspect the optical plummet of the tribrach regularly, because any deviation of its line of sight from the vertical axis will result in a centring error.

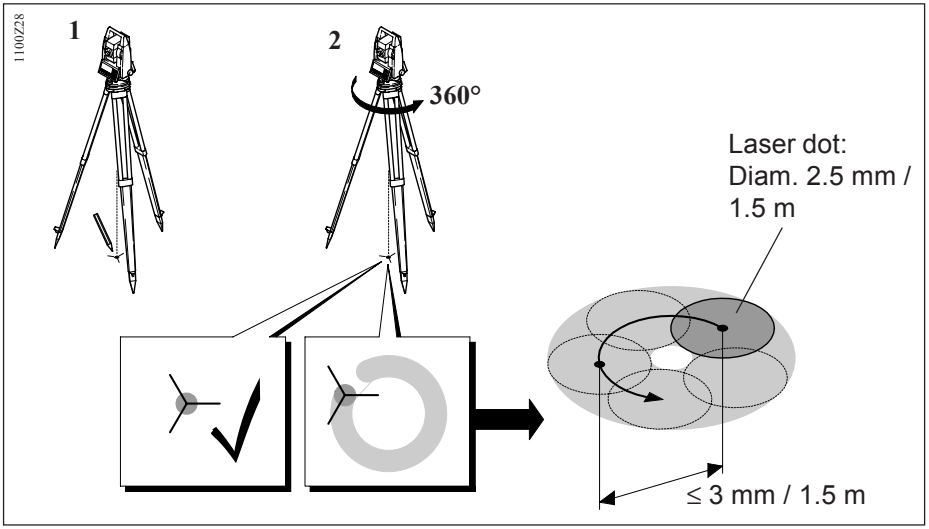
The laser plummet is located in the vertical axis of the instrument.

Under normal conditions of use the laser plummet does not need adjusting. If an adjustment is necessary due to external influences the instrument has to be returned to any Leica Geosystems service department.

Inspecting by turning the plummet 360°:

1. Place the instrument on the tripod and level it up.
2. Switch on the laser plummet and mark the centre of the red dot.
3. Slowly turn the instrument through 360°, carefully observing the movement of the red laser dot.

Inspection of the laser plummet should be carried out on a bright, smooth and horizonal surface (e.g. a sheet of paper).



If the centre of the laser dot describes a perceptible circular movement or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest Leica Geosystems service workshop.

Depending on brightness and surface, the diameter of the laser dot can vary. At a distance of 1.5 m it will be about 2.5mm.
The maximum diameter of the circular movement described by the centre of the laser point should not exceed 3 mm at a distance of 1.5m.

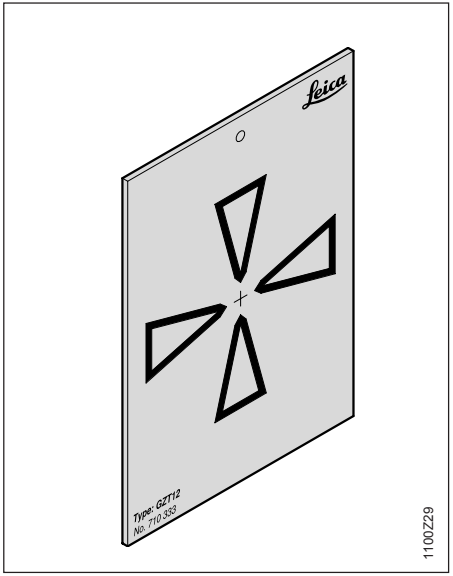
The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam will coincide with the visual line of sight. External influences such as shock or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

The direction of the beam should be inspected before precise measurement of distances is attempted, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

Inspection

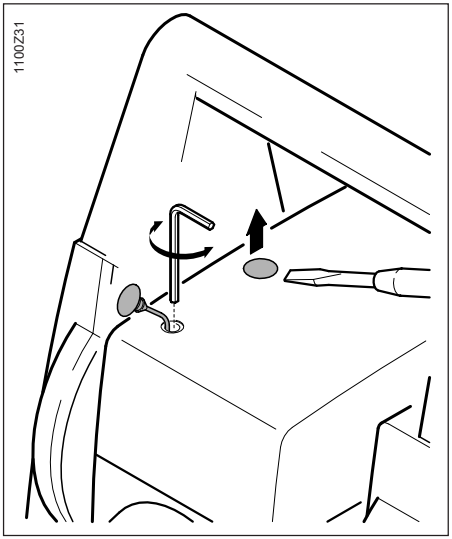
A target plate is provided. Set it up between five and 20 metres away with the grey reflective side facing the instrument. Move the telescope to face II. Switch on the red laser beam by activating the laser-point function. Use the telescope crosshair to align the instrument with the centre of the target plate, and then inspect the position of the red laser dot on the target plate. Generally speaking the red dot cannot be seen through the telescope, so look at the target plate from just above the telescope or from just to the side of it.
If the dot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

If the dot on the more reflective side of the plate is too bright (dazzling), use the white side instead to carry out the inspection.



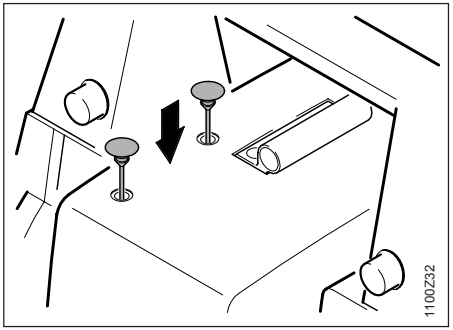
Adjusting the direction of the beam

Pull the two plugs out from the adjustment ports on the top side of the telescope housing.
To correct the height of the beam, insert the screwdriver into the rear adjustment port and turn it clockwise (dot on target plate moves obliquely upwards) or anticlockwise (dot moves obliquely downwards).
To correct the beam laterally, insert the screwdriver into the front adjustment port and turn it clockwise (dot moves to the right) or anticlockwise (dot moves to the left).



Throughout the adjustment procedure, keep the telescope pointing to the target plate.

After each adjustment, replace the plugs in the ports to keep out damp and dirt.



This section describes the system functions of the TPS1100 instruments.
The presentation of the dialogs, and the sequence and names of the individual functions, are in accordance with the basic TPS1100 configuration.

Data job (D JOB) and meas. job (M JOB)

A distinction is made between:
- Input data, which are generally fixed-point coordinates, and
- Output data, which are generally measurements, coordinates, or values derived from "new points."

It is useful to store the input data and the output data in two separate files, although they can be stored together in one file.

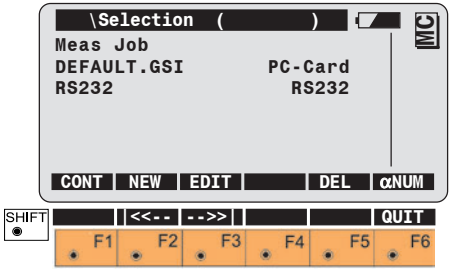
Up to 60 files can be managed.
The names of the files can be chosen freely, but the extension must always be GSI (e.g. "PROJ2563.GSI").

In the directory \LOG, additional data from most of the loadable applications can be stored in a protocol file.

The data can be output in GSI format to the serial interface instead of on to the PC card.

If the data is stored on the serial interface, no data from the applications will be output to the protocol file. Fixed-point coordinates can be read only from the PC card.

The following dialog (e.g. measurement file) can be basically used to create, edit and delete files.



F1 Selects the file required.

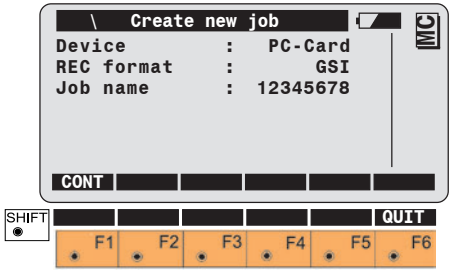
F2 Creates new measurement file (see dialog opposite).

F3 Displays and edits files.

F5 Deletes file.

SHIFT F2 Jumps to the first file in the list. This key is not assigned if the file displayed is already at the beginning of the list.

SHIFT F3 Jumps to the last file in the list. This key is not assigned if the file displayed is already at the end of the list.

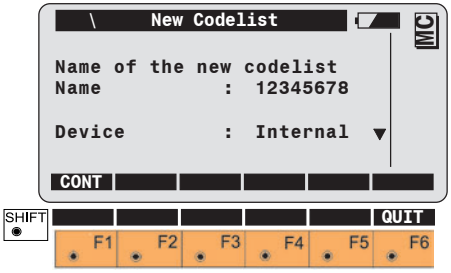


F1 Creates a new file having the file name which was entered.

This function enables to create a standard codelist. Existing standard codelists, point codelists and mixed codelists can be edited, deleted and copied. For the instrument to recognize the codelist and to access it, the codelist must be saved under the name *.CRF in the "CODE" directory.

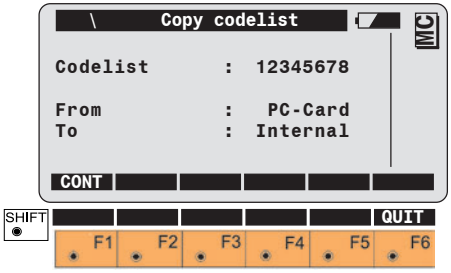
The assignations of the keys, and the subsequent course of the program, are the same as in the dialog "Meas. job", with the exception of the additional function on F4 (COPY).

Only so-called "standard codelists" can be created on the instrument.



F1 Creates a codelist with the file name entered.

This function enables a codelist to be copied from one data carrier to another.

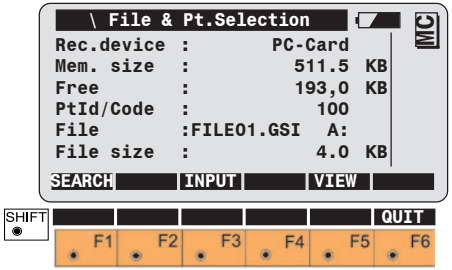


Display of the selected codelist, the "source data carrier" and the "target data carrier".

F1 Copies the codelist.

The following three general dialogs are also then reused in the descriptions of the functions "OPEN", "VIEW", "SEARC" and "INPUT".

Selecting and searching for file / point



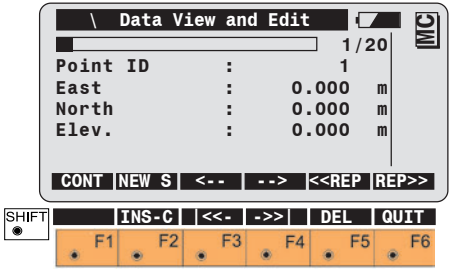
Selecting the file name and entering the search criterion and the complete point number or code number.

F1 Starts a search in the current file.

F3 Enters the coordinates.

F5 Displays the data found.

Display of point data found



In the first line, the bar provides a graphical representation of the position of the point within the complete file. There follows the running number, and then the total number of data sets within the file.

F1 Transfers the displayed values to the appropriate function or application.

F2 Starts a search for new points. Jumps to the display "File & Pt. Selection".

F3 Displays the points in a sequence going towards the beginning of the file.

F4 Displays the points in a sequence going towards the end of the file.

F5 Repeats the search for the point number, going towards the beginning of the file, in order to find points stored more than once with the same point number or with wild cards (placeholders).

F6 Repeats the search for the point number, going towards the beginning of the file, in order to find points stored more than once with the same point number or with wild cards (placeholders).

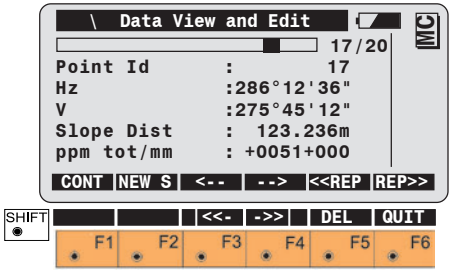
SHIFT F2 Inserts a codeblock (Code, Info1…8) in the active file before the displayed measurements.

SHIFT F3 Jumps to the first block in the file. This key is not assigned if the first data set is already displayed.

SHIFT F4 Jumps to the last block in the file. This key is not assigned if the last data set is already displayed.

SHIFT F5 Deletes the displayed data.

Number of GSI data found



The data is displayed point by point in accordance with the recording mask in use at the time of the storage. The data displayed can therefore change from one point to another.
The assignations of the keys, and the subsequent course of the program, are the same as in the dialog "Data View and Edit", with the exception of the following function:

SHIFT F5 Deletes the displayed data block from the file. A message is called to confirm that you want to delete the block.

This function searches in the current data job for the coordinates of the point required. It accepts the first data set found after the start of the file, but does not display this data set.

If no point data are found, a message is displayed along with the note that no points with this point number were found.
With "NEW S", the dialog "File & Pt. Selection" is called. The file for the data search can be changed and/or a new point number can be entered.

Or:

The missing data can be entered with "INPUT".

This function searches in the current data job for the coordinates of the required point. The first data set found after the beginning of the file is the one accepted. The data set found is displayed in every case.

If point data are found, refer to the dialog "Data View and Edit". "CONT" accepts the values displayed, and terminates the function.

Or:

Using "NEW S", call the dialog "File & Pt. Selection". The file for the data search can be changed and/or a new point number can be entered.

If no point data is found, a message appears with the note that no points with this point number were found.

Using "NEW S", call the dialog "File & Pt. Selection". The file for the data search can be changed and/or a new point number can be entered.

Or:

Using "INPUT", enter the missing data.

This function searches in the current measurement file for data relating to the required point. The user has the option of displaying the data stored on the PC-card within a chosen file and to delete data blocks. Individual points, and multiple entries of points with the same point number, can be searched for, displayed and deleted. The last point number in the file is displayed automatically. If editing of the data is permitted, point numbers, code information, attributes, instrument height and reflector height can all be changed. True measurement data such as directions and distances cannot be changed.

To activate the dialog "File & Pt. Selection", refer to the appropriate dialog.

If no point or code is found, a message is displayed along with the note that no point or code was found in the current measurement file.

If a point or code is found, refer to the dialog "Data View and Edit".

Placeholder (wild cards) in searching for points

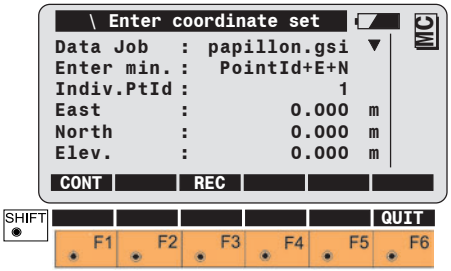
The search for stored data can be made easier if a placeholder is used instead of the complete point number. In the TPS1000, a decimal point "." is used instead of the more usual star "*", because it is more easily entered. There is no entry corresponding to "?".

Example of the use of placeholders:

Input	Results	Remarks
11.	11, 110, 1101, 11ABC5, 111111	**After** 11 there can be any character and in any amount.
.11	11, ABC11, 11111	**Before** 11 there can be any character in any amount.
1.0	10, 100, 1ABCD0, 11111110	**Between** 1 and 0 there can be any character and in any amount.
.10.	10, 3410ABC, 111110, 1000000	A 10 must be **present at least once**
.1.0.	10, 341ABC0, 1123Z0Y, 1001A000	A 1 must be present **in frount of** a 0 **at least once**, and any amount of characters can be present between them.

If a number with placeholder is entered instead of the complete point number, the **controlled data search** is always started and the first matching data set is displayed. The subsequent procedure is the same as that used when entering a complete point number.

This function enables point coordinates to be entered and stored in the current data file.



F1 Transfers the displayed values to the calling function.

F3 Sets the point data and stores them in the data file. The height is stored only if a value has been entered.

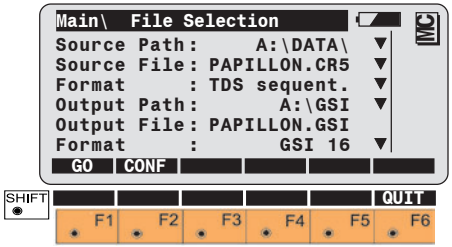
This function permits the conversion of coordinates (P, E, N, (H)).

Three different file formats are supported:

- GSI (Leica Geosystems standard format) = *.GSI
- ASCII (normal ASCII text files) = *.ASC
- TDS (Tripod Data Systems) = *.CR5

After the function has been called, the dialog shown on the next page appears, permitting rapid selection of the original file and its format and also input of the name of the target file (output file) and its format.

Conversion dialog



Source Path
Selects the directory for the source file.

Source File
Selects the name of the source file.

Format
Selects the file format.
There is a choice between the following formats:
GS18, GSI16, ASCII, TDS sequential, TDS non-sequential.

Output Path
Selects the directory for the output file.

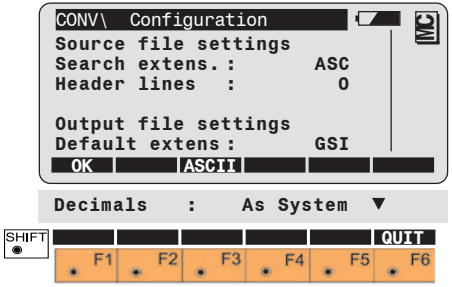
Output File
Enters the name of the output file.

Format
Selects the file format.

F1 Starts the conversion.

F2 Calls up the configuration.

Configuration dialog



Source file settings
Search extens.
Determines the file extension to be searched for.

Header lines
Determines the number of lines to be jumped at the beginning of a source file, i.e. which should not be converted (range of values 0-999).

Configuration dialog (continued)

Settings for output file
Search extens.
Determines the extension for the output file.

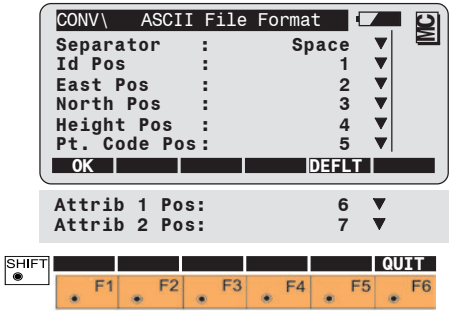
Decimals
Determines the number of decimal places in the output if this is not limited by the format (e.g. by GSI). Choice between "As System" and up to six decimal places.

F1 Returns to conversion dialog.

F3 Calls the ASCII - configuration dialog.

ASCII configuration dialog

The ASCII file format can be defined in the ASCII configuration dialog. The defined format is valid for ASCII source files and ASCII output files.



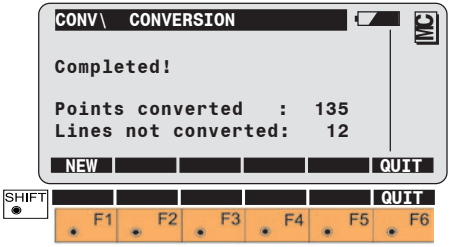
Separator
Determines the separator between the data during output. Spacing, commas and tabulator can be set.

PtId, East, North,... Position
The position in the ASCII format has to be defined for each component ("None" or 1,..,10 can be set).

F5 Reset to the default settings (as shown above).

Closing dialog

The closing dialog indicates the end of the conversion and shows the user how many lines were converted and how many not.

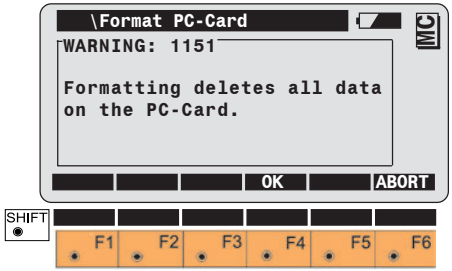


Points converted
Output of the number of successfully-converted points.

Lines not converted
Output of the number of lines not converted.

F1 Starts new conversion and calls the conversion dialog.

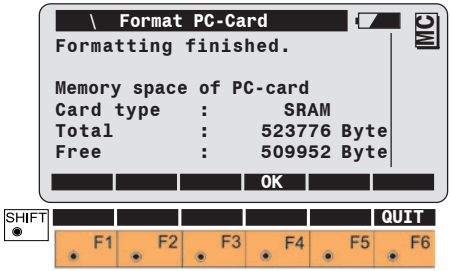
F6 Quits the function.



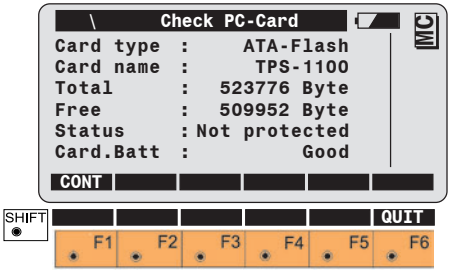
Formatting the PC-card irretrievably deletes all data.

F4 Confirms the formatting is to go ahead. The storage capacity of the PC-card is ascertained and the card is formatted accordingly.

F6 Aborts the function "Format PC-Card".



After the formatting is complete, the total memory capacity and the memory available on the card are displayed. The difference between the total memory capacity and the available memory is used for managing the directories.



Display of the type of card (SRAM or ATA-Flash).

Display of the total memory capacity and the available memory.

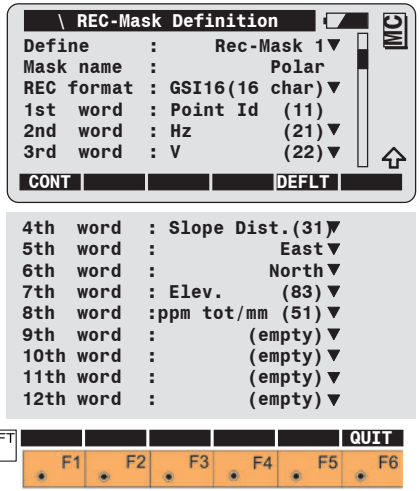
Display of the write-protection function:
NOT PROTECTED or PROTECTED.

Display of the battery status (only for SRAM cards):
GOOD or LOW. (If LOW appears, fit a new internal battery for the PC-card immediately).

Activates the function "**REC-Mask Definition**".

Five REC masks can be defined for recording measurement data, and one REC mask for setting the station data.

The first line (point number) cannot be changed. For the remaining 11 lines, the data to be recorded can be selected from a list.



F5 Sets the current REC mask to "Standard", i.e. to the REC masks originally defined.

In contrast to the display mask, the parameters in the recording template can be set only once.

If Point Codes and Attributes need to be stored , it must be defined in the recording mask. If attributes are defined in the display mask, they can directly be entered in the measuring dialog.

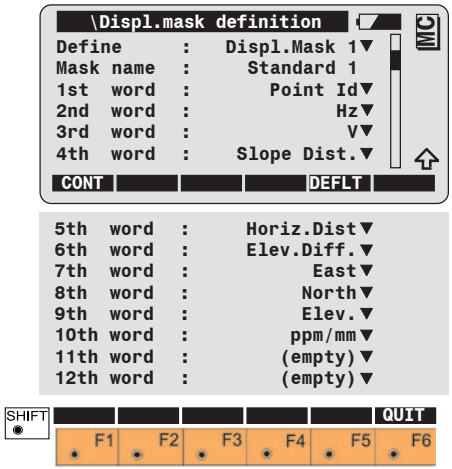
The standard REC masks are different from the standard display mask. The REC mask does not include the reflector height, for example. If the heights of targets are to be inspected in the office, the attribute "Refl. Height" must be added to the recording mask.

Setting the display mask (DMask)

Activates the function from the "**DISPLAY MASK**" dialog.

Three DSP masks can be defined.

The 12 lines can be set up by using the parameters available from the lists.



Each line can display any and all of the available display data.

F5 Sets the current DSP mask to "Standard", i.e. to the DSP masks originally defined.

Complete list of display and recording parameters

(*) = only on the record screen

WI-No.	Parameters	Description
--	\empty	Empty line
--	Displ.Mask	Current display mask
(*) 58	Add.const.	Prism constant
--	Backs. Id	Current backsight Id
(*) 72 (*) 73 (*) 74 (*) 75 (*) 76 (*) 77 (*) 78 (*) 79	Attrib. 1 Attrib. 2 Attrib. 3 Attrib. 4 Attrib. 5 Attrib. 6 Attrib. 7 Attrib. 8	Attributes (1-8) can be used to store additional information in the field. Each of the editable parameters can contain up to 8 or 16 alphanumeric characters. Contrary to CODE-words, Point codes and Attributes are stored within the measurement data block, as long as the record mask contains attributes.
--	AVG n max.	Maximum number of distance measurements in the averaging mode
41	Code	Code blocks serve to record additional information used in further processing of the measurement data. The codes are stored in blocks separate from the measurement data blocks and contain at least one CODE-word and up to87 more information words (Info 1 to 8).
--	Code Mngmt	Codelist managment: view, select, create, edit
--	Code Descr	Description for the current code
--	Codelist	View and select Codelist
--	Data job	View and select Data-Job
--	Date	Current date
--	DJob Mngmt	Data-Job management: view, select, create, edit

WI-No.	Parameters	Description
--	Offs. Elev.	Elevation offset of target point
--	Offs. Lngth	Length offset of target point
--	Offs.Cross	Cross offset of target point
--	Offs.Mode	View and select offset mode, reset after REC or keep
--	Half line space	Half empty line
(*) 32	Horiz.dist.	Horizontal distance (reduced slope distance)
(*) 21	Hz	Horizontal direction
(*) 83	Elev.	Target point height (Z)
(*) 33	Elev.Diff.	Height difference between the station point and the target point with allowance made for the instrument and reflector heights
(*) (11)	Indiv.PtId	Current individual point number
42 43 44 45 46 47 48 49	Info 1 Info 2 Info 3 Info 4 Info 5 Info 6 Info 7 Info 8	Additional information to the Code. Each of these editable information words can contain up to 8 or 16 alphanumeric characters.
--	Increment	Increment to encrease the running point id
(*) 88	Inst.Ht	Instrument height
(*) (11)	Runn.PtId	Current running point id
--	Meas job	View and select Meas-Job
--	EDM Prog.	View and select EDM program
--	MJob Mngmt	Meas-Job management: view, select, create, edit
(*) 52	n / s	Number of averaged distances measured and the standard deviation in millimetre
(*) 82	North	North coordinate of target point

WI-Nr.	Parameters	Description
(*) 81	East	East coordinate of traget point
--	ppm atm.	Atmospheric ppm value
--	ppm geom.	Geometric ppm value
(*) 59	ppm total	Total ppm-correction
(*) 51	ppm/mm	Total ppm-correction and prism constant
--	PtC.Descr.	Description for the current Code
(*) 71	Point Code	Current Point Code
(*) 11	Point Id	Current Point Id (either the running or the individual point id)
(*) 87	Refl. Ht.	Reflector height
--	Refl. list	View and select a reflector
--	Refl.Name	Display the current reflector name
--	Displ.Mask	View and select the recording mask
(*) 31	Slope Dist	Measured slope distance (already corrected using ppm and prism constant)
--	Station Id	Station point number
(*) 86	Stn.Elev.	Station Elevation (Zo)
(*) 85	Stn.North	Station northing coordinate (Xo)
(*) 84	Stn.East	Station easting coordinate (Yo)
(*) 22	V	Vertical angle
--	V-Display	View and select the V angle display
--	Last PtId	Display of the last recorded Point Id
--	Prev.Code	Display of the last recorded Code
--	Prev.PtCod	Display of the last recorded Point Code
--	Time	Current system-time
--	Target Typ	Current target type, reflector or none

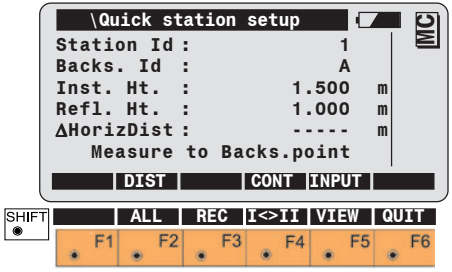
Display and recording parameters can be defined independently. Therefore make sure that the recording mask contains all parameters necessary for evaluation.

If values "East" and then "North" are defined in the display mask and if the coordinate display shows "Easting/Northing" then also the Easting value followed by the Northing value appears in the measurement mode. However, in connection with the display mask and the display in the measurement mode four cases must be considered:

DMask	Coord. Seq.	Display in measurement mode	Change
Easting/Northing	E/N as in DMask	Easting/Northing	none
Easting/Northing	change E/N Seq.	Northing/Easting	yes
Northing/Easting	E/N as in DMask	Northing/Easting	none
Northing/Easting	change E/N Seq.	Easting/Northing	yes

Single-point orientation (quick station setup)

This function brings together in a single dialog all of the relevant inputs needed to set up the instrument from scratch.
Activate the function "Quick-station setup (QSET)".



Enter the numbers of the station point and of the backsight point respectively. The appropriate point is immediately searched for in the data file and, if the search is successful, the coordinates will be assigned to the station point and backsight point without this fact being displayed.

After the instrument height and the reflector height have been entered, target the backsight point and measure the distance and/or the direction.

F2 Measure the distance. The difference between the calculated distance and the measured distance to the backsight point is displayed.

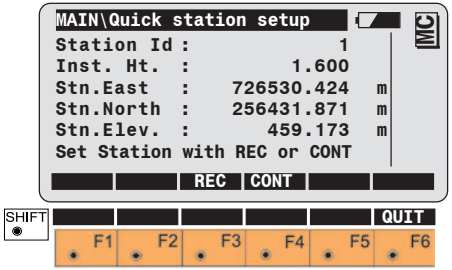
F4 Determine the direction, but do not store the values. The graduated circle is orientated.

F5 Using the keyboard, enter the coordinates for the station or for the tie point. *See chapter "Data management"*.

SHIFT F2 Measure the distance and determine the direction, and store the measurement block. The graduated circle is orientated. The difference between the calculated distance and the measured distance to the backsight point is displayed.

SHIFT F3 Determine the direction and store it, including the previously-measured distance where appropriate. The graduated circle is orientated.

SHIFT F5 Activate controlled data search within data file. *See chapter "Data management"*.

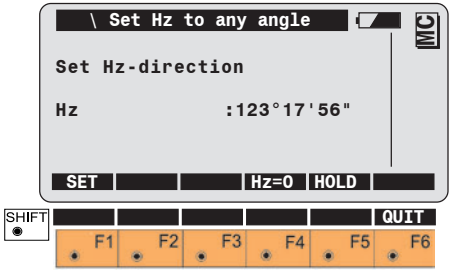


F3 Station data are set.

F4 Station data are set and are stored in the measurement file.

Activate the function "Set Hz to any angle".
Target the tie point exactly.
The direction must always be set using face I.

Set Hz direction to 0° 00' 00" (0.0000 gon) or enter a known value.



F4 Sets Hz to 0° 00' 00" (0.0000 gon).

Instead of entering a value, this can be set by turning the instrument.

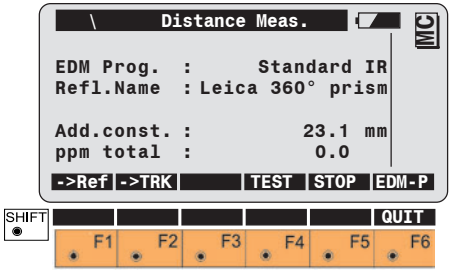
F5 Secures the value (clamp the circle)

Target the tie point exactly.

F5 Releases the circle.

This function is also activated from other dialogs in order to enter the Hz direction.

The following dialog is displayed during the "first" distance measurement:



The display shows the current measuring program and reflector, the current additive constant (prism constant) and the total ppm value.

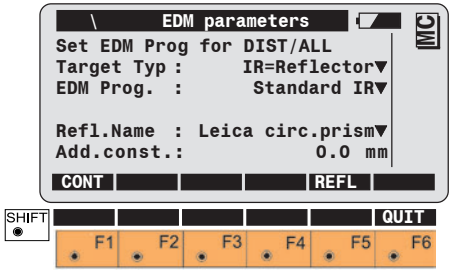
F1 Switches between infrared (with reflector, →REF) and red laser (no reflector, RL).

F2 Activates the tracking mode if the measuring program "Standard distance measurement" was selected, or the rapid-tracking mode if the measuring program "Fast distance measurement" was selected.

F4 Calls the EDM test (signal and frequency)

F5 Stops the current measuring program.

F6 Calls the function " EDM parameters".



Infrared:

Standard IR
Normal distance measurement.
Accuracy 2mm+2ppm.
Measuring time 1.0 seconds.

Standard Fast IR
Rapid distance measurement.
Accuracy 5mm+2ppm.
Measuring time 0.5 seconds.

Tracking IR
Continuous measurement.
Accuracy 5mm+2ppm.
Measuring time 0.3 seconds.

Tracking Fast IR
Continuous measurement.
Accuracy 10mm+2ppm.
Measuring time <0.15 seconds.

Average IR
Repeat measurements in standard measuring mode with display of the number of distance measurements ($2 \leq n \leq 999$), the current average and the standard deviation for the averaged distance.

Very short distances may be measured reflectorless in Infrared-mode (e.g. to well reflecting targets like traffic signs). In this case the distances are corrected with the addition constant defined for the active reflector.

Reflector-free and long range: (red laser)

Standard Long RL
Normal distance measurement.
Accuracy 3mm+2ppm.

Average Long RL
Repeat measurements in normal measuring mode

WARNING:
(only for Extended Range Instruments)

Reflector-free:
The visible laser beam may only be used within a controlled area (*refer to chapter "Safety Directions"*) and must hit a non reflecting material at the end of its intended path.
Long Range to prisms:
This mode is only permissible from a distance of 1000 m (3300 ft) from the telescope. No persons may stay within the beam path up to 1000 m (=controlled area; *refer to chapter "Safety Directions"*).

Selecting the target type

This line appears only if a reflectorless instrument is being used. There is a choice between "reflectorless" and "reflector".

Wrong target type setting leads to bad measurements.

Refl.Name

The current reflector is indicated and, on the next line, the additive constant associated with it.

F5 Calls the function "Reflector selection".

Wrong prism setting leads to bad measurements.

[>REF] Activates infrared distance measurement (with reflector). The last used ATR/LOCK settings are simultaneously activated.

[>RL] Activates reflectorless distance measurement.

Switch between Standard/Tracking

[>STD] Activates standard distance measurement.

[>TRK] Activates distance tracking.

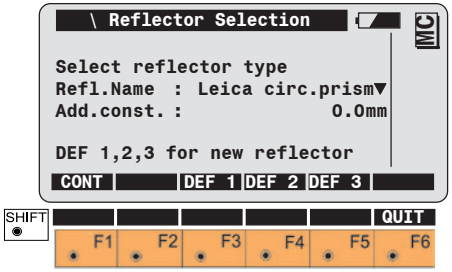
Switch between Fast measurement/Rapid Tracking

[>RTRK] Activates rapid distance tracking.

[>FAST] Activates rapid distance measurement.

Setting / defining prisms

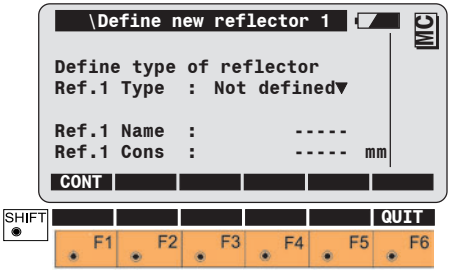
Activating the function "**Reflector selection**".



Choosing the appropriate prism. The appropriate additive constant is set automatically at the same time.

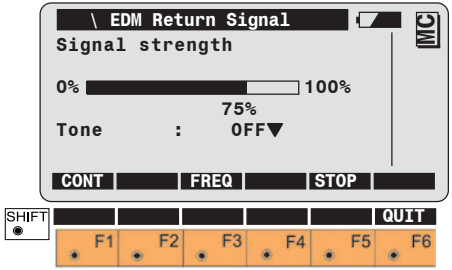
Wrong prism setting leads to bad measurements.

F3, F4, F5 Define reflectors from other manufacturers.



The user can freely define the name and additive constant (additive constant) for three reflectors and can enter the type of reflector (prism or retro tape). The additive constant is always given in millimetres [mm]. It is advisable to determine the additive constant for "non Leica Geosystems prisms" on a baseline by means of an appropriate procedure.
For the reflector to be available for choice, the reflector type may not be "None".

Displays the signal strength or measurement frequency.



F3 Toggles between the displays of measurement frequency and signal strength. The measurement frequency display is similar to the display shown above.

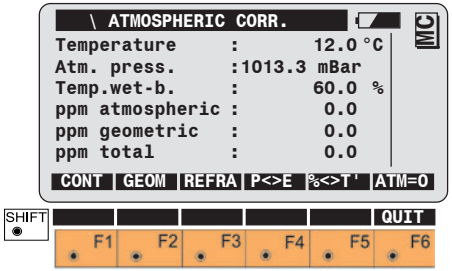
F5 End and return to the previous dialog.

ON/OFF - key for the acoustic tone. The stronger the signal the more the black intensity bar is extending to the right against 100%. With an already low signal distances can be measured.

A distinction is made between atmospheric (ppm) and geometric (ppm) corrections, the sum of which is used as the final distance correction.

Atmospheric correction

The atmospheric distance corrections are derived from the dry-air temperature, air pressure or height over mean sea-level, and relative air humidity or wet-air temperature.



F2 Settings for the geometrical correction.

F3 Settings for the refraction correction.

F4 Toggle between air pressure and height above mean sea-level.

F5 Toggle between relative air humidity and wet-air temperature.

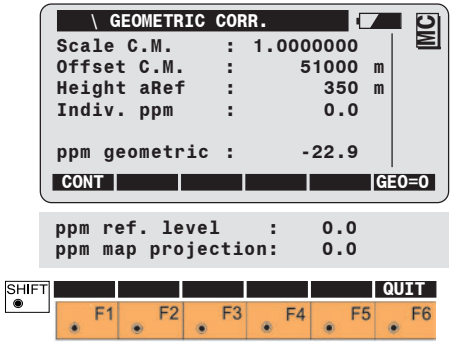
F6 Set the atmospheric ppm to "0.00". (Individual parameters are set to the standard atmospheric values, corresponding to the atmospheric correction ATM=0)

Geometrical correction

The geometrical distance correction is derived from the projection distortion and the height above the reference datum.
The calculation of the geometrical ppm follows the formula for the Transversal Mercator Projection.
The individual factors are: the scale factor of the line of projection (central meridian, Gauss-Krüger = 1.0, UTM = 0.9996, etc.); the offset from the line of projection; the height above the reference datum (normally this is the height above mean sea-level); and an additional individual scale correction.

The distance without any projection distortion is used to determine the height difference. The individually-set scale adjustment is always applied to the distance.

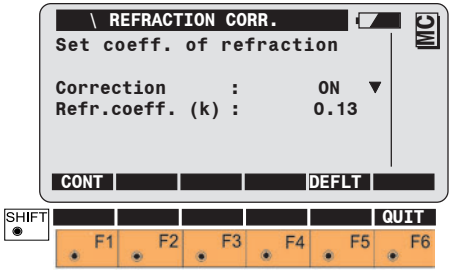
The individual scale correction can be used to enter a total geometrical correction.



F6 Sets the geometrical ppm to "0.00".
The scale on the Central Meridian is set to "1.0000000". The other parameters are set to "0.00".

Refraction correction

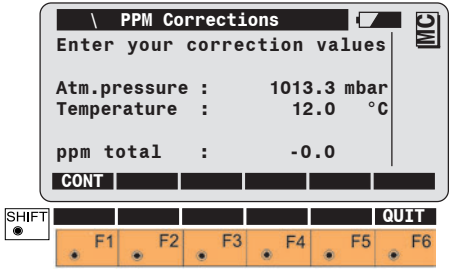
The refraction correction is taken into account during the calculation of the height difference.



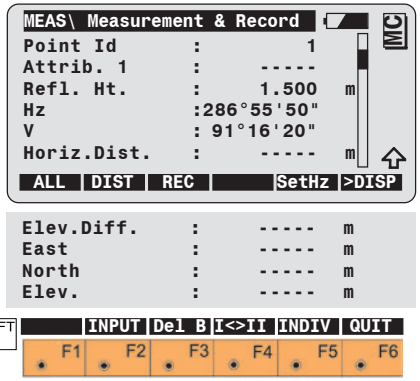
F5 Sets the refraction coefficient to standard values.

For standard applications the distance is corrected only on account of atmospheric influences.
The geometrical correction and the projection distortions are set to "0.00". Heights are reduced with the standard refraction coefficient

Activate the function "**PPM Atmospheric**" from the dialog "**Function Selection**".



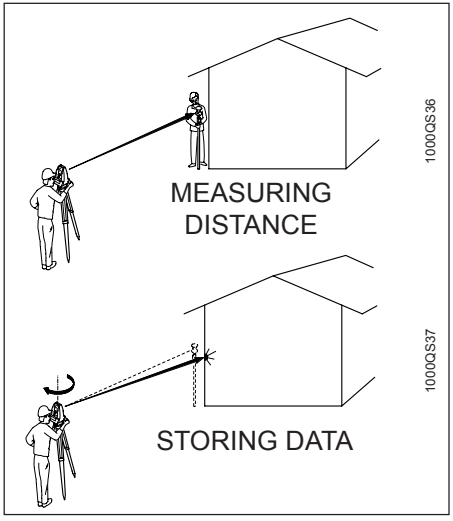
Input of air pressure and temperature
or
Input of ppm value.
The values for pressure and temperature are erased.



The data shown above represent the standard display mask.

F3 Measurement block recording. The recorded measurement-block corresponds to the active recording template. The last measured distance is also recorded.

This procedure offers the option of realigning the telescope on another point after measuring the distance and before measuring the angle. In this way two points can be used for measurements of angle and distance.
It is therefore possible to record inaccessible points, e.g. house corners, fences surrounded by hedges.



For calculations which depend on distance, the V-angle after completion of the distance measurement is used, along with the current Hz-direction. Consequently, calculated heights and height differences are retained and the coordinates for easting and northing which correspond to the new Hz direction are recalculated using the last-measured distance.

The V-angle displayed corresponds to the position of the telescope on completion of the distance measurement. The V-angle is not altered until the measurement is recorded for a new distance is measured.

When distances, heights, or height differences are displayed as empty fields (i.e. -----), the V-angle is continuously displayed and updated.

If, after the distance has been measured, changes are made to the target-point data which have an influence on the distance measured or on the height and height difference (e.g. ppm, prism constant, reflector height, refraction coefficient), the dependent data will be correspondingly re-computed.

Measuring distances and angles together with storage (ALL)

Hz-angle measurement is carried out after the distance has been measured. Immediately afterwards all data is stored.
The measurement block stored in the meas.job corresponds with the active recording mask.

Therefore the instrument may only be moved after data storage is complete.
This is signalled acoustically by the third beep after the ALL key has been pressed.

The data is automatically recorded after the distance has been measured. The distance, and all data which depend on it, are then displayed with the tag "-----", which indicates that the data storage is complete.

Storing station data (REC)

The station data (point number, easting, northing, station height, reflector height and instrument height) are recorded in the measurement job. The coordinates are set as station coordinates.

Changing face (I< >II)

Positioning in the other face. Display of DHz and DV. If the instrument is turned so that these values are at "0.000", the target becomes visible in the telescope again. This aid is an advantage under conditions of poor visibility.

If the instrument is motorized, the instrument automatically travels to the other face.

Last point number (L.Pt.)

Enter the last point number to be stored and use it as the current point number.

Deleting the GSI block (Del B)

This function deletes the last GSI block of the current measuring job. With "Del B", a measuring block (starting with WI11) or a code block (starting with WI41) can be deleted.

Manual distance entry

Enter the horizontal distance, which was measured with a tape for instance.
Immediately after confirmation of input, the horizontal distance is shown corrected for the geometrical ppm. After the distance has been entered, the V-angle is set to "horizontal" 90° (100 gon) or 270° (300 gon). The coordinates are calculated using the corrected horizontal distance, the Hz-direction, and the V-angle. Heights are always corrected for earth curvature and are corrected for refraction according to the parameter settings.

The reflector height is temporarily set to the value for the instrument height and so there is always a height difference of "0.000".
The slope distance is the same as the horizontal distance.

(Applies only to motorized instruments)

The telescope is automatically pointed at the latest point to be stored. This function is available only if a point was stored after switching on the instrument.

[>FREE] This function activates the vertical angle mode "Running" for the following measurements. In this mode, the vertical angle is continuously updated with the telescope movement.

After a distance measurement, vertical angle, slope distance, height difference, and the elevation coordinate are displayed as running values. Slope distance, height difference, and the elevation coordinate of the target point are calculated from the initial horizontal distance and currently displayed vertical angle. The REC-function records the displayed values in the measurement file.

[>FIX] This function activates the vertical angle mode "Hold after DIST" for the following measurements. In this mode, the vertical angle is fixed after a distance measurement, whereas the horizontal angle is running.

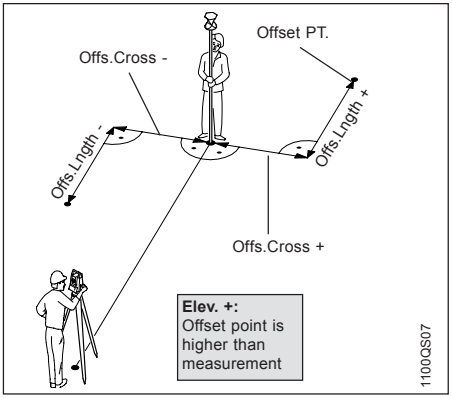
Function [VRUN]

This function deletes the last measured distance and so releases the locked vertical angle.

(Available only with special configuration.)

The Offset function allows offset points to be determined, for instance when the reflector cannot be set up directly on a point. Transverse, longitudinal and/or elevation offsets can be defined from the reflector position to the offset point.
All of the displayed and recorded measurement data are calculated in relation to the offset point.

The values for target eccentricity will be retained after storage with the choice of "Permanent" in the Offset Mode. The values will be set to zero with the choice of "No reset after REC".



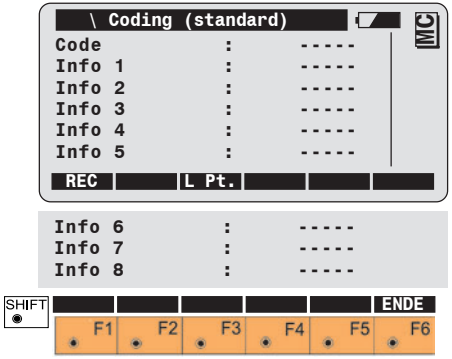
This function is for switching between the display masks. If no mask is defined, or only one, this function key does not appear.

This function is for switching between the individual [INDIV] and running [RUN] point numbers.

Standard coding (without codelist)

Code blocks are used to record additional information for subsequent processing of the measurement data. They are recorded in separate blocks and consist of at least the CODE number, along with up to 8 further information blocks (Info 1 to 8). Each of these editable information words contains up to 8 (or 16) alphanumeric characters.
Information words which include "-----" are not stored.
In general, the code function can be called whenever a measurement or another data set in the measurement file can be stored. The code function, together with the measuring mode, is available in most of the loadable applications.

CODE calls up the standard coding (Code, Info 1 to 8) if no codelist was selected.



F1 When a new code is entered, or after using the - F3 key, "REC" is assigned to the - F1 key. Only information-bearing elements are recorded.

Standard codes (Code, info 1 to 8) are recorded in separate blocks in GSI format behind the last measurement stored. These codes are not part of the recorded data block (recording template).

F3 Calls the latest codes stored, and also the WIs.

WIs for storage:

Code: WI 41
Info 1 - 8: WI 42 - 49

Point coding (without codelist)

In the TPS1000 instruments, the so-called "Remarks" (REM words) were used for storing additional information in the measurement-data blocks, but in the TPS1100 they have been replaced by "Point code" and "Attrib. 1-8".

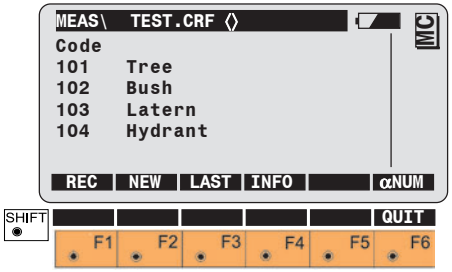
WIs for storing:

Point code: WI 71
Attrib. 1-8: WI 72-79

Standard coding with codelist

This function becomes active if a standard codelist has been selected.

The fixed key CODE is used for calling up the codelist.



F1 Stores the code block.

F2 Creates a new code.

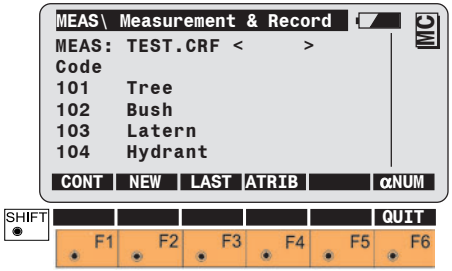
F3 Calls the latest code stored.

F4 Enters information.

F6 Switches between numeric and alphanumeric input for a rapid search of codes.

Point coding with codelist

This function becomes active if a point code list has been selected. In the measurement dialog, the codelist is displayed in the line "point code". The list is opened with direct input or with ↵ .



F1 Confirms the selection.

F2 Creates a new point code.

F3 Calls the latest point code.

F4 Enters attribute values.

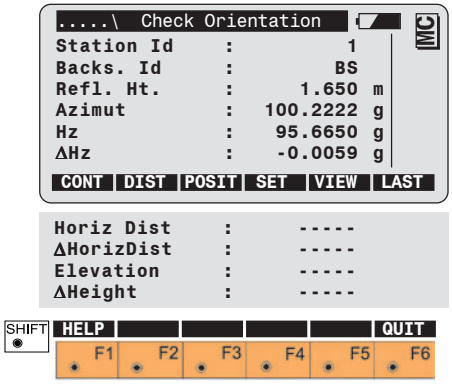
F6 Switches between numeric and alphanumeric input for a rapid search for codes.

This function enables a measurement block and a code block for a predefined code to be stored by pressing a key (Quick-Coding). Up to 100 codes defined in the codelist can be called with the numerical keys in this manner (default 10 codes).

The quick coding can be switched on and off with "QCod+ / QCod-". When quick coding is active, the symbol "C" is displayed in the bottom of the graphical status field of the measurement display. When the quick-coding option is switched off, this symbol disappears.

The Check Orientation dialog allows to check the orientation to a known backsight point, and to reset the orientation if necessary.

Activating the function "Check Orientation".



Enter the Backsight Id. With ↵ the appropriate point will immediately be searched for in the data file and, if the search is successful , the coordinates will be assigned to the backsight point.
Additionally the calculated azimuth to the point will be shown.

After the reflector height has been entered, target the backsight point and measure the distance and/or the direction and compare azimuth with HZ.

F1 Leave the dialog and continue work.

F2 Measure distance. Distance and difference between calculated and measured distance to the backsight point will be shown.

F3 Position the telescope to the backsight point. For motorised instruments only!

The instrument positions automatically back to the start position when leaving the "Check Orientation" function. This is particularly suitable for RCS-applications.

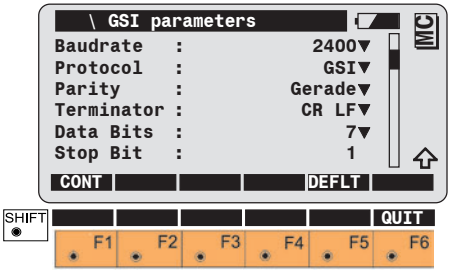
F4 Target the backsight point accurately and reset the orientation.

F5 Search and display the coordinates of the point found in the active data job.

F6 If Orientation was set more than once, LAST recalls the last backsight point and azimuth.

GSI communication parameters

The setting for the interface parameters is valid for communication with the GSI command structure. The baud rate can be chosen from the standard values between 2400 and 19200.



F5 The standard parameters are shown above.

For more detailed information about command- and data structure, please refer to "WILD Instruments On-Line" (document no. G-366-0en), a copy of which is available (in English only) from your local Leica Geosystems agency.

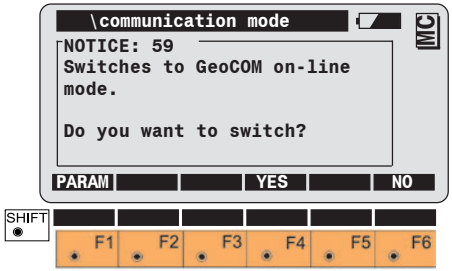
Interface parameters (GeoCOM)

The settings of the interface parameters are valid for communication using the "GeoCOM command structure". The baud rate can be chosen from a list of standard values between 2400 and 19200. All other parameters are fixed and cannot be changed.

For more detailed information about command- and data-structure, please refer to the handbook "GeoCOM Reference Manual" (document no. G-560-0en), a copy of which is available (in English only) from your local Leica Geosystems agency.

The setting for the interface parameters is valid for communication in remote-control mode. The baud rate can be selected within the range 2400 - 19200. No other values can be altered.
For detailed information, please refer to the separate instructions for use.

With on-line operation (GeoCOM), the instrument is switched to a mode which permits communication with, or control by, a data recorder or PC. This mode operates across the RS232 interface; the GeoCOM command set is used.



F1 Calls the settings for the GeoCOM communications parameters.

F4 Activates the "On-line mode". The operation of the instrument is now totally controlled across the interface. For information about data structures, and for the detailed structure of the control commands, please refer to the "GeoCOM Reference Manual"(G-560-0en), which is available only in English. The on-line mode can be quitted by pressing "OFF" (F6).

F6 Reverts; "On-line" mode is not activated.

TCA and TCRA instruments are motorized and equipped with Automatic Target Recognition (ATR) coaxially in the telescope. The EGL guide light, mounted on the telescope, is optional.
These instruments permit automatic angle and distance measurements to normal prisms and reduce the tedium of precise visual sighting to prisms. The prism is sighted with the optical sight only. Initiating a distance measurement will turn the instrument with the help of the motors to sight the prism-centre automatically.
The angles V and Hz are measured to the centre of the prism at the completion of the distance measurement.

As with all other instrument errors, the collimation error of the automatic target recognition (ATR) must be redetermined periodically *(Refer to chapter "Checking and Adjusting").*

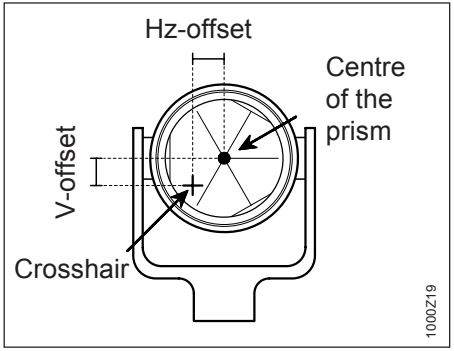
Reflections or foreign lights (eg. from car headlights) can affect the ATR-measurement.

The built-in Automatic Target Recognition ATR1 transmits a laser beam. The reflected light is received by the built-in camera (CCD). The position of the received light spot with respect to the centre of the CCD is computed and the offsets are used to correct the horizontal and vertical angles. The offsets are also used to control the motors which turn the instrument so that the crosshairs are centred on the prism.

In order to minimize the times for measuring, the crosshair is not moved to the exact centre of the prism. The offset can be up to 5mm. Then the Automatic Target Recognition ATR1 measures the offsets between the crosshair and prism centre and corrects the Hz and V angles accordingly.

Therefore the Hz and V angles are measured to the prism-centre, regardless of the crosshair pointing precisely to the centre of the prism.

If the offset is more than 5mm when the prism is exactly aligned and in faultless condition, the Automatic Target Recognition ATR1 must be recalibrated. If excessive offsets occur frequently, contact your Leica Geosystems agency.



The telescopic field of view is the active field of the ATR. Within this area the prism is identified immediately.

The following functions are valid only for TCA and TCRA instruments.

ATR-Mode (ATR+ / ATR-)

This mode permits the automatic recognition of stationary targets.

The observer must first use the optical sight to target the prism approximately so that it is located within the telescopic field of view.

When the distance measurement is triggered, the motors move the crosshair close to the centre of the prism to make distance measurement possible.

LOCK-Mode (LOCK+ / LOCK-)

Lock-mode will enable TCA instruments to follow a moving prism. Distances can be measured whenever the prism stops for a short time (Stop and Go mode).

The icon is shown in the lower left area of the status field when the LOCK-mode is activated and before a prism is found.

Switching to LOCK mode requires an initial distance measurement so that ATR1 "learns" the prism.

This measurement is the same as the initial measurement in ATR mode.

If the prism is subsequently moved, the telescope tracks it automatically for as long as the prism is aligned to the instrument.

The displayed angles refer to the crosshair direction during search. Once the prism is static, a distance measurement can be activated using "**DIST**" or "**ALL**". In this case the angles are measured on the centre of the prism after the distance measurement.

After a distance measurement, these corrected angles (for the centre of the prism) are displayed or recorded.

The icon is shown in the lower left area of the status field if the **LOCK** mode is active and if the telescope tracks the prism

Any interruption to the tracking of the prism is indicated for about two seconds graphically in the lower left status field by the symbol and also by a continuous acoustic signal (beep).

The LOCK mode is interrupted (LOCK Interrupt), e.g. to measure inbetween to faraway targets without prism (eg. church spires). After the distance has been measured, the ATR immediately returns to its original condition.

This function should be used for measuring to a second prism (Changing the prism).

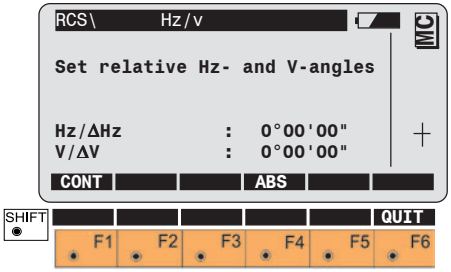
The icon is shown in the lower left area of the status field, once the L.INT-mode is activated. Measured angles refer to the direction of the crosshair.

At the completion of the distance measurement or after pressing L.GO, the LOCK mode is reactivated and the corresponding icon is shown in the lower left area of the status field.

(Valid only for motorized instruments)

The telescope is automatically pointed at the latest point to be stored. This function is available only if a point was stored after the instrument was switched on.

PROG F2 Activates the Hz/V mode.



In Hz/V mode, the TPS1100 can be turned by set angle values.

The input options are:

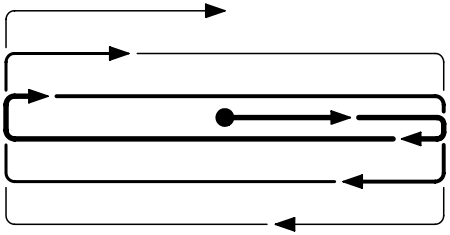
- absolute angle values which relate to the orientation of the TPS1100
- relative angle values which cause the TPS1100 to turn away from its present position by the amount entered.

F1 Quits the Hz/V mode and starts the search mode, if ATR is activated.

F4 Switches between absolute (ABS) and relative (REL).

If the reflector is in the telescope's field of view, the crosshair is automatically positioned to the reflector when a measurement is triggered. If the target is not within the telescope's field of view, an automatic reflector search is started. Instruments equipped with the option PowerSearch can be switched to PowerSearch mode for a quick detection of prisms.

The shape of the ATR search window is rectangular and the defined area is scanned line by line starting in the center of the searching window.



Depending on the working mode of the instrument different sized search windows and different search strategies are used.
The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function. In RCS mode, a working area can be additionnally defined. This area is automatically scanned if the local search was not successful.

- **ATR and LOCK modes:**

The operator stands at the instrument and can manually position the telescope to the reflector at any time. When a measurement is triggered, a small search window (Hz: 2.5gon / V: 2.5gon) is used to find the reflector as quickly as possible.
If the target is lost in LOCK mode the path of the reflector is predicted for a few seconds.

- **RCS mode:**

The operator stands at the reflector and directs the telescope to the target with his preferred positioning mode (e.g. joystick). Because the telescope can only be positioned roughly when standing at the reflector, bigger search windows are used in RCS mode. If a search is triggered manually by pressing ALL or DIST the RCS Searching Window (default size Hz: 30gon / V: 15gon) is scanned starting at the current position of the telescope.

- The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function.
- A Working Area can be defined in RCS mode. This area is scanned automatically if the local search was not successful.

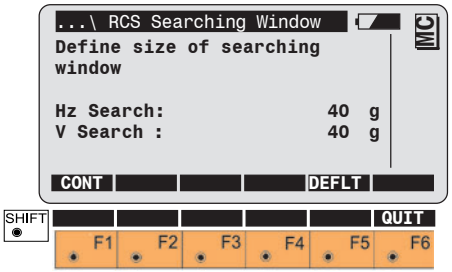
If the target is lost in LOCK mode first the path of the reflector is predicted for a few seconds followed by a search which will by carried out mainly in horizontal direction. The size of the search window depends on the shape of the predicted path. If a Working Area is activated then the entire Working Area is scanned after the respective local searches.

- **PowerSearch**

Instruments equipped with PowerSearch have the quick prism search feature. When PowerSearch is activated, the instrument performs a 360° rotation around its standing axis. If the laser swath of the PowerSearch sensor detects a prism, the rotation is stopped and the ATR performs a fine aiming in vertical direction. If a working area has been defined, PowerSearch is only active within the defined limits.

RCS Searching Window

With this function the dimensions of the RCS Searching Window can be defined. If an automatic reflector search is started by pressing ALL or DIST in RCS mode, a search window with the predetermined dimensions is scanned at the current position of the telescope.



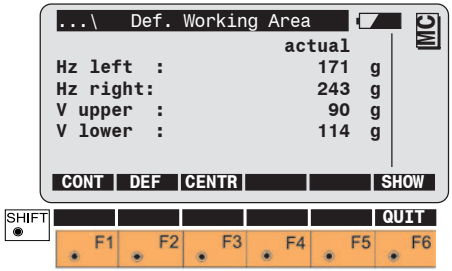
Hz Search extent of search window in Hz-direction

V Search extent of search window in V-direction

F1 To confirm the displayed values and leave the dialog.

F5 Returns all values to default values.

With this function a Working Area can be defined in which the instrument automatically searches for the reflector when working in RCS mode.



Hz left left boundary of working area

Hz right right boundary of working area

V upper upper boundary of working area

V lower lower boundary of working area

F1 To confirm the displayed values and return to the previous dialog.

F2 To define a new working area by pointing the telescope to two opposite corners of the working area (left corner - opposite right corner).

F3 To centre the working area to the current telescope position (retains the same size of the WA).

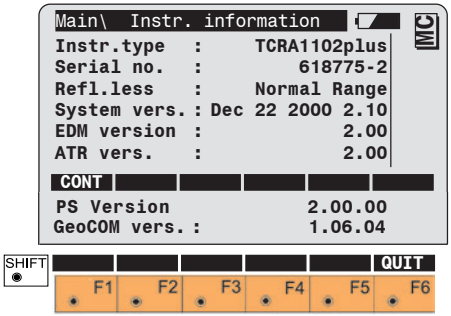
F6 To position the telescope to the upper left / lower right corner of the defined Working Area.

If the instrument is in RCS mode and the determined working area is activated then the entire working area is scanned for the reflector if the target was not found by the standard search method at the current position of the telescope.
If the working area is deactivated only the standard search methods at the current position of the telescope are performed.

The instrument follows the reflector even if the reflector is outside the Working Area.
If the target is lost outside the Working Area a local search will be started. If the reflector was not found the predefined Working Area is scanned.
On instruments with the optional PowerSearch, the working area can be used to limit PowerSearch to a certain area and when activated, PowerSearch only scans within the defined limits.

Instrument designation and software version (INFO)

This function displays the most important systems information.



Display of instrument type, serial number, RL EDM type, software version and creation date, EDM version, ATR version, PS (PowerSearch) and GeoCOM version.

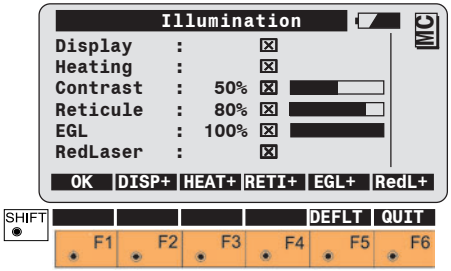
Electronic bubble (LEVEL)

Please refer to the description in the section "Levelling-up with the electronic bubble".

Switches on the back lighting and crosshair.

Settings for:
- Back lighting (display) on/off
- Heating of display on/off
- Contrast of display
- Brightness of crosshair illumination
- Brightness of EGL guide light (optional)
- Eyepiece diode laser on/off (optional)
- Red laser on/off (optional)

The current settings are displayed numerically as percentages and graphically as a bar diagram. Optional settings are possible only if the instrument is additionally equipped.



F2 Switches the back lighting on and off.

F3 Switches the display heating on and off.

F4 Switches the crosshair illumination on and off.

F5 The assignment of the function key depends on the equipment installed:
Switches the guide light on and off (EGL); key assignment "EGL+" .

Or:

Switches the eyepiece diode laser on and off; key assignment "DIOD+".

F6 Switches the visible red laser on and off (only for TCR/TCRM instruments).

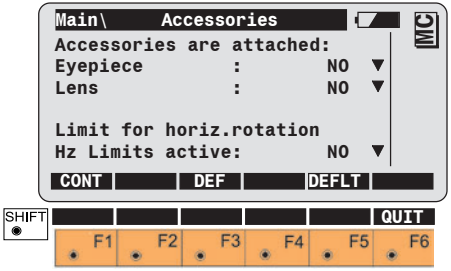
WARNING:
(only for Extended Range Instruments)

If the visible red laser is switched on do not aim at prisms or reflecting objects through or beside the optical sight. Aiming against prisms is only allowed by looking through the telescope. Using the laser pointer is only permissible within a controlled area (*refer to chapter "Safety Directions"*).

SHIFT F5 Sets standard values (contrast 50%, crosshair 80%).

At extremely low temperatures or in very bright ambient light conditions the contrast should be set to a higher value than 50%.

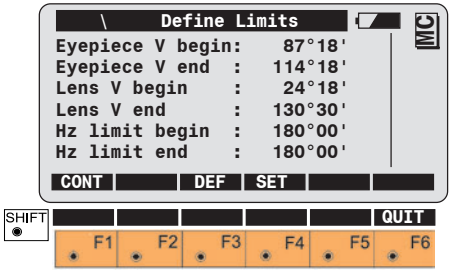
If an accessory such as the eyepiece prism or an additional lens for measuring to retro foils is used, then the movement for motorized instruments is restricted by preset values.



F3 Sets the limits of the movement

F5 Returns all settings to NO.

A starting value and a finishing value are displayed. These determine the limits of movement of the telescope for motorized instruments. The range of movement between the starting value and the finishing value is defined by one clockwise rotation. The limits are entered for the vertical angle for the objective side (lens) and for the eyepiece side, and for the horizontal directions. The altered values are retained when the instrument is switched off.



Values can be entered directly with the keyboard, or they can be determined through the position of the telescope.

F3 Moves the telescope to the position of the appropriate limiting value. The value displayed changes during the movement.

F4 Accepts the value displayed as being the limit of movement.

Eyepiece V begin Starting value for V-angle of eyepiece.

Eyepiece V end Finishing value for V-angle of eyepiece.

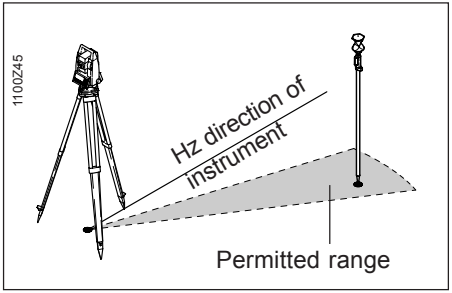
Lens V begin Starting value for V-angle of objective.

Lens V end Finishing value for V-angle of objective.

Hz limit begin Starting value for Hz-direction.

Hz limit end Finishing value for Hz-direction.

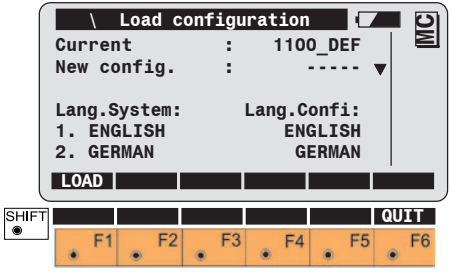
If the Hz direction of the instrument is outside the permitted range but the target is within it, the instrument can still rotate itself towards the target.



Rotation towards target possible

If the Hz direction of the instrument is within the permitted range but the target is outside it, rotation is not possible and an error report appears.

The functions for transferring information between the internal memory and the PC-card are described below. For transfer via RS232 the Leica SurveyOffice PC software is generally used, in which event the instrument is remote-controlled and requires no user interface.



Selects the configuration files from the PC-card in the directory "\tps\conf\".
Displays the languages available in the system or which belong to the configuration file.

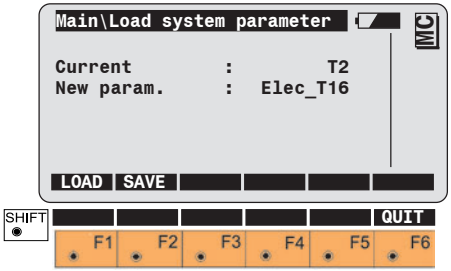
F1 Loads the new configuration.

If no file can be found, the message 659 appears along with the note that no configuration file was found.

A precautionary interrogation (message 658) appears before the actual loading and asks for confirmation of the intention to load a new configuration.

"NO" will then abort the function.
"YES" will load the configuration.

Loading a system-parameter file

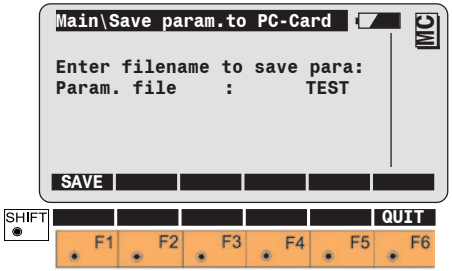


Select the new system-parameter files from the PC-card.

F1 Loads the new system-parameters.

F2 Stores the current system-parameters.

The following display appears:



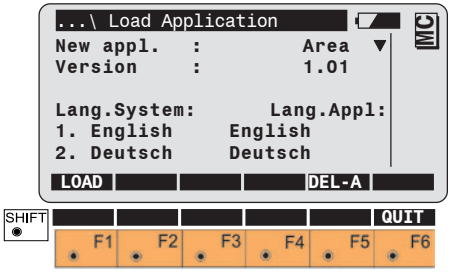
Input the name of the system-parameter file to be saved.

F1 Stores the file on the PC-card.

General parameters

This section describes the system-parameters of the TPS1100 instruments.

Load application

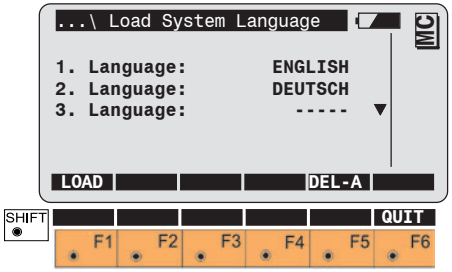


Selects the application from the PC-card in the directory "\tps\appl\".
The column at the right of the diplay shows in which languages the application will be loaded.

F1 Loads the selected application.
New application versions can be loaded directly; it is not necessary to delete the existing application before.

F5 Deletes the selected application.

Load system language



Selects the system languages from the PC-card in the directory "\tps\lang\".
An existing system language can not be overwritten: it must be deleted first.

F1 Loads a selected system language.

F5 Deletes a selected system language.

Date

Sets the date.
Choice of layout: 09-11-98 or 11.09.98.

Date form.

Selects the date format.
Choice of layout:
Day/Month/Year
Month/Day/Year
Year/Month/Day

Time

Sets the time.

Time form.

Sets the time format.
Choice between 24h clock and 12h clock with am/pm

Alpha mode

The alphanumeric input can be either through the function keys or through the numeric keys. If numeric keys are used, there is a choice between "Numeric keys" and "Numeric extended". In "Numeric extended" mode, more characters are available.

Key beep

Sets the volume of the beep emitted when the keys are pressed. The beep is always active for messages. There is a choice between beep off (None), soft beep (Low) and loud beep (Loud).

Autoexec.

Selects the application, which will then be started automatically immediately after switching on.
The list includes the following permanently-available options: "Main menu", "Measurement & Recording" and "Enter Station Data". Also, all of the applications programs loaded are listed.
The function or application selected is automatically started whenever the instrument is switched on.

Language

Selects the system language (a maximum of three languages can be stored). English is always available and cannot be deleted.

Dist. Unit

Units of distance measurement:

Metre	Metres (m)
Int.Ft	International feet, storage in US feet [fi]
Int.Ft/Inch	Int. feet, inches and 1/8 inches (0' 00 0/8fi), storage in US feet [fi]
US Ft	US feet [ft]
US Ft/Inch	US feet, inches and 1/8 inches (0' 00 0/8fi) [ft]

Dist. Dec.

Decimal places for distance:

Metre	0,1,2,3
Int.Ft	0,1,2,3
Int.Ft/Inch	0
US Ft	0,1,2,3
US Ft/Inch	0

Angle Unit

Units of angle measurement:
400gon
360° ' "
360° dec
6400 mil

Angle Dec.

Decimal places for angle:

TCx1101/1102:
- 400 gon, 360°'", 360°dec. => 2, 3, 4
- 6400 mil => 1, 2, 3

TCx1103/1105:
- 400 gon, 360° dec. => 2, 3, 4 (in steps of five units)
- 360°'" => 2, 3, 4
- 6400 mil => 1, 2, 3

Temp. Unit

Units of temperature

° C	Degrees Celsius
° F	Degrees Fahrenheit

Press. Unit

Units of atmospheric pressure

mbar	millibars
mm Hg	millimetres of mercury
inch Hg	inches of mercury
hPa	hectopascals
psi	pounds per square inch

Coord. Seq.

Sequence of coordinates in display

North / East (X, Y)
East / North (Y, X)

For further information, please refer to the section "GSI parameters".

Hz system

Sense of Hz-circle system

North Azimuth(+)	Clockwise angle measurement (+) starting at North
North anticlw (-)	Anticlockwise angle measurement (-) starting at North
South Azimuth	Clockwise angle measurement (+) starting at South

Face I

Definition of faces:

V-drive left	Vertical drive on the left side
V-drive right	Vertical drive on the right side

Compensator

ON Switches on the compensator, which measures the longitudinal and transverse tilts of the vertical axis. The V-angles are relative to the plumb line.

OFF Switches off the compensator. appears in the status display. The V-angles are relative to the vertical axis.

The working range of the two-axis compensator is 6' (0.10 gon) for each axis.

Hz-Corr.

ON Switches on the Hz correction.
The Hz measurements are corrected for the following errors:
1. Line-of-sight error
2. Tilting-axis error
3. Standing-axis tilt (only for compensator ON).

OFF Switches off the Hz correction.
The Hz measurements are not corrected.
appears in the status display.

Examples of compensator / Hz corrections:

1. Compensator **ON**, Hz corrections **ON**.
   The V-angles are relative to the plumb line. The Hz measurements are corrected for line-of-sight error, tilting-axis error and standing-axis tilt.
2. Compensator **ON**, Hz corrections **OFF**
   The V-angles are relative to the plumb line. The Hz measurements are not corrected for line-of-sight error, tilting-axis error or standing-axis tilt.
3. Compensator **OFF**, Hz corrections **ON**
   The V-angles are relative to the standing axis. The Hz measurements are corrected for line-of-sight error and for tilting-axis error.
4. Compensator **OFF**, Hz corrections **OFF**
   The V-angles are relative to the standing axis. Hz corrections are not applied.

Sect. Beep

Hz sector beep
Sets the beep (ON/OFF) for angle sectors.

Sect. Angle

Hz sector angle
Enters the angles for which a beep should sound.
When the angle approaches 4°30' (5 gon), the beep becomes regular.
At 27' (0.5 gon) the beep is continuous.
At 16" (0.005 gon) there is no beep.
The angle count always commences at 0°00'00" (0.0000 gon).

Release V-angle

Running This parameter activates the vertical angle mode "Running" for the following measurements. In this mode, the vertical angle is continuously updated with the telescope movement.

Pay attention to the following when using V-angle setting "running" for the determination of remote heights:
The active reflector height is applied in the calculation of remote point elevations. The reflector height must be manually set to zero to display and record the elevation of the targeted remote point.

After a distance measurement, vertical angle, slope distance, height difference, and the elevation coordinate are displayed as running values. Slope distance, height difference, and the elevation coordinate of the target point are calculated from the initial horizontal distance and currently displayed vertical angle. The REC-function records the displayed values in the measurement file.

Hold after DIST This parameter activates the vertical angle mode "Hold after DIST" for the following measurements. In this mode, the vertical angle is fixed after a distance measurement, whereas the horizontal angle is running.

V-Display

Selects the V-angle display

- **Zenith angle**
  V = 0 in zenith
- **Elev. angle**
  V = 0 in horizontal (elevation angle)
  V-angles are positive above the horizon and negative below it.
- **Elev. angle %**
  V = 0 in horizontal
  V-angles are expressed in % and are positive above the horizon and negative below it.

Power mode

Sets automatic switchoff criteria. These become effective after the set time has elapsed, provided that the keyboard and interface have not been used meanwhile.

Selects the switch-off option

- **Sleep after ...**
  Goes into sleep mode after the number of minutes set. In this energy-saving mode the power consumption is reduced by about 60%. Active functions and applications can be resumed after waking.
- **Auto off after ...**
  The instrument switches off automatically after the number of minutes set.
- **Remains on**
  The instrument remains permanently switched on.

Power Time

Selects switchoff time in minutes:
Enters the time after which the instrument is to go into power-saving mode or to switch off.

Dist. Delay

Enters how long the display should appear during the distance measurement (values between 0 and 3 seconds are possible).

PPM entry

Choice between display mask for reduced distance corrections (ppm atmospheric) for standard applications and display mask for extended distance corrections (ppm atmospheric + geometrical).

PPM Atmospheric
Direct input of the ppm value (ppm total) or input of temperature and pressure for automatic calculation of ppm atmospheric.

PPM atmospheric + geometrical
A distinction is made between atmospheric corrections (temperature, relative air humidity and air pressure) and geometrical corrections (projection distortion, scale factor and height above the reference datum), the sum of which is used as the final distance correction.

Info / Atrib

Display of the last attribute entry

Default value
The default value defined in the codelist is displayed and can be overwritten.

Last user value
Instead of default values or choicelists, the last entered values (Info's/Attributes) are displayed for each code.
Note predefined default values for Infos and attributes are overwritten by the last entered values and can not be anymore recovered!

Auto Dist

ON Activates automatic distance measurement after choice of EDM-program with function key.

OFF Deactivates automatic distance measurement after choice of EDM-program with function key.

Pt. Id. mode

In the measurement dialog and in the programs, the Point Id is defined as a running point number with corresponding increment.

Mode "Change to Indiv":
The user can enter individual Point Ids manually at any time. After recording, the active running Point Id will be displayed again.

Mode "Remain running":
The manual entry of a new Point Id defines a new running Point Id.

Offs. Mode

Determines whether the values for target eccentricity are to be retained after storage or are to be set to zero (choice between "Permanent" and "No reset after REC").

Increment

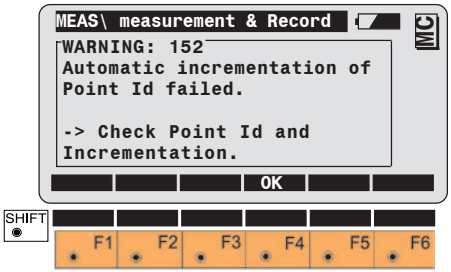
Incrementation of point numbers
Numeric and alphanumeric components of the running point number can be incremented individually, enabling the incrementation to be defined as a numerical template.

For example, the running point number 12A2001 is incremented by 102001 after the point number 12B22002 has been stored, and then again for the point number 12C23003, and so on.

Letters can be from A - z (ASCII 065 - 122). In this connection it is not possible to transfer numbers to letters and vice-versa and within the alphanumeric range.

Examples:

Pt.Id.	12z001	12A999	12Az100
Increment	1000	000001	1001000
Explanation	no transfer of letters to numbers	no transfer of numbers to letters	no transfer of letters



F4 Confirms the warning and the change in the point number or in the increment.

Meas Job

Displays the measuring jobs which are available and selects the appropriate one.

Data Job

Displays the data jobs which are available and selects the appropriate one.

Codelist

Displays the code lists which are available and selects the appropriate one.

Quick-Code

Stores the code block before or after the measurement if the quick-code method is used. Choice between "REC before ALL" and "REC after ALL".

Introduction

This chapter describes the data structure and organization of the Leica Geosystems GSI (Geo Serial Interface). The GSI data structure is used for all data transferred between the Leica Geosystems electronic survey instruments, and also defines the data stored internally. The following information describes the data structure of the TPS1100 instruments and contains some specific features only applicable to these instruments.
Data transferred between a Leica Geosystems instrument and a computer will conform to the GSI data structure (also called GSI data format).

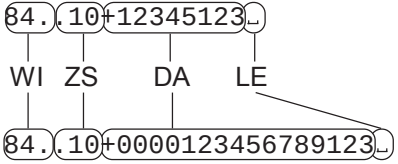
Format with 8 or 16 characters

There is a choice between storing 8 characters (places) or 16.

From Version 2.20 onwards, there is a choice of two GSI formats, with word lengths of 8 and 16 characters respectively. When 16 characters are stored and supported the following special conditions apply:

- A measurement block is tagged with * at the first position.
- A data word includes the data at positions 7 to 23 instead of at 7 to 15.

GSI-8 format



GSI-16 format

WI	Word index
AI	Additional information
DA	Data
BL	Blank = separating character

Block concept

Data transmitted by instruments over the GSI interface is composed of blocks. Each one of these data blocks is treated as a whole, and ends with a terminator (CR, or CR LF). There are two types of data block:

1 Measurement blocks
2 Code blocks

Measurement blocks contain a point number and measurement information. They are designed primarily for triangulation, traverse, detail, and tacheometric surveys. Code blocks are designed primarily for recording identification codes, data-processing codes and information. However, they can also be used for recording measurement information such as instrument and target heights, and tie distances.

Each data block has a block number. The block numbers start with 1 and are incremented by 1 each time that a new data block is stored.

Structure of a block

A data block consists of words, each with 16 (24) characters. The maximum number of words in the TPS1100 is 12.

Measurement block

The words of a measurement block are determined by the format which is set on the survey instrument.

Example: Measurement block with TPS1000 default values

Word 1	Word 2	.....	.....	Word n	
Point number	Hz direction	V angle	Slope distance	ppm mm	Term

Code block

Word 1	Word 2	.....	.....	Word n	
Code number	Info1	Info2		Info n	Term

The first word of a code block is always the code number. A code block can contain between one and eight words.

Terminator of a data block

The terminator is sent by the instrument after data blocks, after the response sign (?) and after other messages.
The standard terminator is CR/LF (carriage return/line feed). TPS1100 instruments can be set to transmit and accept only CR.

Each word has a fixed length of 16 (24) characters.

W1	w2	.	.	.	.	+	1	2	3	4	5	6	7	8	↵
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Position	Meaning
1 - 2	Word index
3 - 6	Information relating to data
7 - 15 (23)	Data
16 (24)	Blank = separating character

Each word has a two-digit word index to identify it. These two digits occupy the first two positions of the word. Word index numbers lie in the range 01 to 99.

The word indices are listed on the following pages.
In some applications special word indices are used. They are described in the application manuals.

Word identification table

Word index	Description
General	
11	Point number (includes block number)
12	Instrument serial number
13	Instrument type
18	Time format 1: pos. 8-9 year, 10-11 sec, 12-14 msec
19	Time format 2: pos. 8-9 month, 10-11 day, 12-13 hour, 14-15 min
Angles	
21	Horizontal circle (Hz)
22	Vertical angle (V)
25	Horizontal circle difference (Hz0-Hz)
Distances	
31	Slope distance
32	Horizontal distance
33	Height difference
Codebl.	
41	Code number (includes block number)
42 - 49	Information 1-8

Word index	Description
Distance (additional information)	
51	Constants (ppm,mm)
52	Number of measurements, standard deviation
53	
58	Signal strength
59	Reflector constant (1/10 mm) ppm
Point coding	
71	Point code
72 - 79	Attrib. 1-8
Coordinates	
81	Easting (target)
82	Northing (target)
83	Elevation (target)
84	Station easting (Eo)
85	Station northing (No)
86	Station elevation (Ho)
87	Reflector height (above ground)
88	Instrument height (above ground)

All words can be used in measurement blocks except words 41 - 49, which are reserved.

A code block begins with 41, the word index for a code number.

Positions 3 to 6 contain information which relates to the data in positions 7 to 15 (23).

Position in word	Explanation	Applicable to
3	Extension for word index	Digital level
4	Compensator information 0 Automatic height index and monitoring of levelling up: OFF 3 Automatic height index and monitoring of levelling up: ON	All words containing angle information
5	Input mode 0 Value measured automatically 1 Manual input from keyboard 2 Angle: All Hz-corrections for Line of sight error, tilting axis and tilt of standing axis (only with compensator: on): ON Distance: Correction for measurement to vertical prism 3 Angle: All Hz-corrections: OFF 4 Result calculated from functions	All words containing measured data

Position in word	Explanation	Applicable to
6	Units 0 Metre (last digit = 1mm) 1 US-Feet (last digit = 1/1000ft) 2 400gon 3 360° decimal 4 360° sexagesimal 5 6400 mil 6 Metre (last digit = 1/10mm) 7 US-Feet (last digit = 1/10000ft) 8 Metre (last digit = 1/100mm)	All words containing measured data

A point in any of the positions 3 to 6 means that there is no information.

For the data words Point number (WI = 11) and Code number (WI = 41), the block number occupies positions 3 to 6.

Position in word	Explanation	Applicable to
7	Extension of word identification	All words
8-15(23)	The data comprises 8 (16) numeric or alphanumeric characters Note that certain words can contain two data blocks, i.e. pairs. These are transferred automatically, complete with signs, from the survey instrument: e.g. 0123 -035 ppm mm	All words containing data Words 51 - 59

Position in word	Explanation	Applicable to
16 (24)	Blank (separating character)	all words

The last data word of a block must also contain the separating character and CRLF.

Each data block is allocated a block number by the recording device. Block numbers start at 1 and increment automatically.
The block number is contained in the first word of the block. The first word of a measurement block is the point number (WI = 11). The first of a code block is the code number (WI = 41).

The structure of the first word of a data block is as follows:

Position in word	Explanation
1-2	Word index 11 or 41
3-6	Block number (assigned by recording device)
7	Sign + or -
8-15(23)	Point number, code number or text
16(24)	Blank = separating character

Example of data format

This section describes the types of data measured and transmitted by an electronic theodolite.

The GSI data format does not contain a decimal point.
On transferring data to the computer, the decimal point must be inserted by the computer in accordance with the units indicated in position 6 of the word.

Position 6 in data word	Units	Places before point	Places after point	Example
0	Metre (last digit = 1mm)	5	3	12345.678
1	Feet (last digit = 1/1000ft)	5	3	12345.678
2	400gon	3	5	123.45670
3	360° decimal	3	5	123.45670
4	360° sexagesimal	3	5	123.45120
5	6400mil	4	4	1234.5670
6	Metre (last digit = 1/10mm)	4	4	1234.5678
7	Feet (last digit = 1/10000ft)	4	4	1234.5678
8	Metre (last digit = 1/100mm)	3	5	123.45678

Word 1	Word 2	Word 3	Word 4	Word 5
Point no	Hz circle	V circle	Slope distance	ppm mm

The following table shows the structure of a measurement block for 8 characters:

Word	Position	Explanation	Characters
Point number	1 - 2	Word index for point number	11
	3 - 6	Block number (set by recording device)	num
	7	Sign	+,-
	8 - 15	Point number	α num
	16	Blank = separating character	↵
Hz circle	17 - 18	Word index for Hz circle	21
	19	Reserved	.
	20	Automatic index information	2, 3
	21	Input mode	0 - 4
	22	Units	2,3,4,5
	23	Sign	+,-
	24 - 26	Degrees	num
	27 - 28	Minutes (resp. 1/100 grad)	num
	29 - 31	Seconds (resp. 1/10000 grad)	num
	32	Blank = separating character	↵

Word	Position	Explanation	Characters
V circle	33 - 34 35 36 37 38 39 40 - 42 43 - 44 45 - 47 48	Word index for V circle Reserved Automatic index information Input mode Units Sign Degrees Minutes (or 1/100 grad) Seconds (or 1/10000 grad) Blank = separating character	22 . 2, 3 0 - 4 2,3,4,5 +,- num num num ↵
Slope distance	49 - 50 51 - 52 53 54 55 56 - 60 61 - 63 64	Word index for slope distance No significance Input mode Units Sign Metres/feet Decimals of metre/feet Blank = separating character	31 .. 0, 2 0,1 +,- num num ↵
ppm / mm	65 - 66 67 - 70 71 72 - 75 76 77 - 79 80	Word index for ppm, mm No significance Sign ppm sign mm Blank = separating character	51 .... +,- num +,- num ↵
End Character	81 (82)	Carriage Return Line Feed	CR LF

Word 1	Word 2	Word 5
Point No	Hz circle	ppm / mm

The table below shows in detail the layout of a code block:

Word	Position	Explanation	Characters
Codenumber	1 - 2 3 - 6 7 8 - 15 16	Word index for code number Block number (set by recording instrument) Sign Code number Blank = separating character	41 num +,- α num ↵
Information 1	17 - 18 19 - 22 23 24 - 31 32	Word index for Information 1 No significance Sign Information 1 Blank = separating character	42 .... +,- α num ↵
Information 2	33 - 34 35 - 38 39 40 - 47 48	Word index for Information 2 No significance Sign Information 2 Blank = separating character	43 .... +,- α num ↵
Information 3	49 - 50 51 - 54 55 56 - 63 64	Word index for Information 3 No significance Sign Information 3 Blank = separating character	44 .... +,- α num ↵
Information 4	65 - 66 67 - 70 71 72 - 79 80	Word index for Information 4 No significance Sign Information 4 Blank = separating character	45 .... +,- α num ↵
End Char	81 (82)	Carriage Return Line Feed	CR LF

Transport

When dispatching the instrument, always use the complete original Leica Geosystems packaging (case and cardboard box).

When transporting the instrument **in the field**, always make sure that you:
- either carry the instrument in its original transport case
- or carry the tripod with its legs splayed across your shoulder, keeping the attached instrument upright.

Never carry the instrument loose in a **road vehicle**. It can be affected by shock and vibration. Always carry it in its case and secure it.

When transporting the instrument by **rail, air or ship**, always use the complete original packaging (case and cardboard box), or its equivalent, to protect it against shock and vibration.

After transport, or after long periods of storage, inspect the field adjustment parameters given in this user manual before using the instrument.

Maintainance for motorized drives

An inspection of the drives in TCM, TCRM, TCA, or TCRA instruments must be done in a Leica Geosystems service shop:
- After about 4000 hours operation
- Twice a year in case of permanent use of the instrument (e.g. in monitoring applications)

Storage

Temperature limits
(-40°C to +70°C / -40°C to +158°F) Respect the temperature limits when storing the instrument, particularly in summer if the instrument is inside a vehicle.

Damp instruments must be unpacked. Dry the instrument, the case, the foam inserts and the accessories at not more than 40°C / 108°F and clean them. Do not repack until everything is completely dry.

Cleaning and drying

Objective, eyepiece and prisms

- Blow dust off lenses and prisms.
- Never touch the glass with your fingers.
- Use only a clean, soft, lint-free cloth for cleaning.
  If necessary, moisten the cloth with pure alcohol.

Use no other liquids; these may attack the polymer components.

Cables and plugs
Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables. Unplugging connecting cables or removing the PCMCIA card during the measurement may cause loss of data. Always switch off the instrument before removing the cables or the PCMCIA card.

Fogging of prisms

Reflector prisms that are cooler than the ambient temperature tend to fog. It is not enough simply to wipe them. Keep them for some time inside your jacket or in the vehicle to allow them to adjust to the ambient temperature.

Intended use of instrument

The following directions should enable the person responsible for the TPS-System 1100, and the person who actually uses the instrument, to anticipate and avoid operational hazards.

The person responsible for the instrument must ensure that all users understand these directions and adhere to them.

Permitted uses

The TPS-System 1100 electronic theodolites and total stations are intended for the following applications:

- Measuring horizontal and vertical angles
- Measuring distances (TC-models with integrated EDM, T-models with removable EDM)
- Recording measurements
- Computing by means of application software
- Automatic target recognition (with ATR)
- Visualizing the aiming direction (with EGL guide light)
- Visualizing the vertical axis (with the laser plummet).

Prohibited uses

- Use of the product without instruction
- Use outside of the intended limits
- Disabling safety systems
- Removal of hazard notices
- Opening the instrument using tools (screwdriver, etc.), unless this is specifically permitted for certain functions
- Modification or conversion of the instrument
- Use after misappropriation
- Use with accessories from other manufacturers without the prior express approval of Leica Geosystems
- Aiming directly into the sun
- Inadequate safeguards at the measuring station (e.g. when measuring on roads)

- Controlling machines, or controlling moving objects or similar, with the automatic target recognition ATR.
- Deliberate dazzling of third parties

WARNING:

Adverse use can lead to injury, malfunction, and damage. It is the task of the person responsible for the instrument to inform the user about hazards and how to counteract them. The total station is not to be operated until the user has been instructed how to work with it.

Limits of use

Environment:
Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments. Use in rain is permissible for limited periods.

See chapter "Technical specifications".

Area of responsibility for the manufacturer of the original equipment:
Leica Geosystems AG, CH-9435 Heerbrugg (hereinafter referred to as Leica Geosystems):
Leica Geosystems is responsible for supplying the product, including the user manual and original accessories, in a completely-safe condition.

Responsibilities of the manufacturers of non-Leica Geosystems accessories:

The manufacturers of non-Leica Geosystems accessories for the total stations are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

Responsibilities of the person in charge of the instrument:

WARNING:
The person responsible for the instrument must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the instrument and for the safety of the equipment in use.

The person in charge of the instrument has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual;
- To be familiar with local regulations relating to accident prevention;
- To inform Leica Geosystems immediately if the equipment becomes unsafe.

Main hazards of use

WARNING:
The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial, and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the instrument.

WARNING:

The charger must not be used under damp or inclement conditions. If moisture penetrates these devices, the user may receive an electric shock.

Precautions:

Use the charger and the PCMCIA-card reader only indoors, in dry rooms. Protect them from damp. If the devices are damp, do not use them.

WARNING:

If you open the charger, either of the following actions may cause you to receive an electric shock:

- Touching live components;
- Using the devices after incorrect attempts to carry out repairs.

Precautions:

Do not open the charger yourself. Only a Leica Geosystems -approved service technician is entitled to repair it.

CAUTION:

Watch out for erroneous distance measurements if the product is defective or if it has been dropped or has been misused or modified.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the instrument has been subjected to abnormal use and before and after important measurements.

DANGER:

Because of the risk of electrocution, it is very dangerous to use reflector poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

WARNING:

By surveying during a thunderstorm you are at risk from lightning.

Precautions:

Do not carry out field surveys during thunderstorms.

CAUTION:

Be careful when pointing a total station towards the sun, because the telescope functions as a burning glass and can injure your eyes and/or cause damage inside the EDM or the EGL light guide.

Precautions:

Do not point the telescope directly at the sun.

WARNING:

During target recognition or stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around or between the instrument and the target (e.g. obstacles, excavations or traffic).

Precautions:

The person responsible for the instrument must make all users fully aware of the existing dangers.

WARNING:

Inadequate securing of the surveying site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:

Always ensure that the survey site is adequately secured. Adhere to the regulations governing accident prevention and road traffic.

CAUTION:

If a target lamp accessory is used with the instrument the lamp's surface temperature may be extreme after a long working period. It may cause pain if touched. Replacing the halogen bulb before the lamp has been allowed to cool down may cause burning to the skin or fingers.

Precautions:

Use appropriate heat protection such as gloves or woollen cloth before touching the lamp, or allow the lamp to cool down first.

WARNING:

If computers intended for use indoors are used in the field there is a danger of electric shock.

Precautions:

Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems instruments.

CAUTION:

During the transport or disposal of charged batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:

Before dispatching the equipment or disposing of it, discharge the batteries by running the instrument in tracking mode until they are flat.

CAUTION:

If the accessories used with the instrument are not properly secured and the equipment is subjected to mechanical shock (e.g. blows, falling), the equipment may be damaged or people may sustain injury.

Precautions:

When setting-up the instrument, make sure that the accessories (e.g. tripod, tribrach, removable EDM with counterbalance, connecting cables) are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the equipment to mechanical shock. Never position the instrument on the tripod baseplate without securely tightening the central fixing screw.

If the screw is loosened, always remove the instrument immediately from the tripod.

WARNING:

If the equipment is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are

  produced which may impair health
- If batteries are damaged or are heated strongly, they

  can explode and cause poisoning, burning, corrosion, or environmental contamination.
- By disposing of the equipment irresponsibly you

  may enable unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination
- Leakage of silicone oil from the compensator can

  damage the optical and electronic subassemblies.

Precautions:

Dispose of the equipment appropriately in accordance with the regulations in force in your country. Always prevent access to the equipment by unauthorized personnel.

CAUTION:

Only Leica Geosystems - authorized workshops are entitled to repair these products.

The EDM module built into the total stations produces an invisible infra-red beam which emerges coaxially from the telescope objective.
The product is a Class 1 laser product in accordance with:

- IEC 60825-1:1993 "Radiation safety of laser products"
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

The product is a Class I laser product in accordance with:

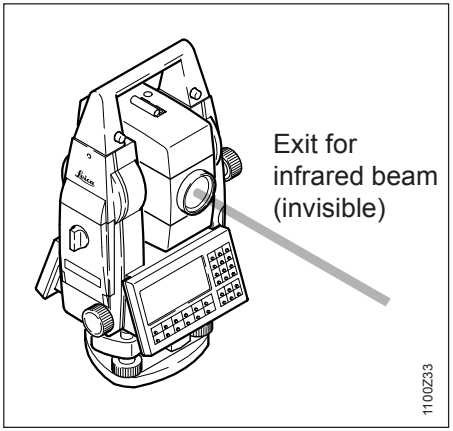
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

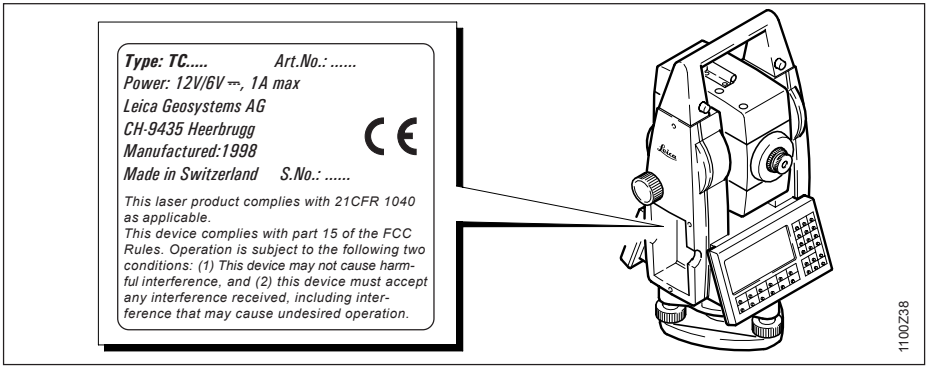
Class 1/I laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

Class 1 Laser Product

according to IEC 60825-1:1993

Beam divergence:	1.8 mrad
Pulse duration:	800 ps
Maximum radiant power:	0.33 mW
Maximum radiant power per pulse:	4.12 mW
Measurement uncertainty:	± 5%




Type: TC..... Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland S.No.: .....
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
1100Z38

As an alternative to the infrared beam, the EDM incorporated into the total station produces a visible red laser beam which emerges from the telescope objective.

WARNING:
Two types of distancers with visible laser are available:

- Total stations with distancers of **laser class 3R resp. IIIa** - identifiable by:
  - the type plate in the battery compartment **with** note to "+Reflectorless Ext. Range",
  - a laser emission indicator lamp on the eyepiece side of the telescope cover,
  - a warning label below the memory card compartment: "Laser class 3R" and "Class IIIa LASER PRODUCT".
- Total stations with distancers of **laser class 2 resp. II** - identifiable by:
  - the type plate in the battery compartment **without** note to "+Reflectorless Ext. Range",
  - a warning label below the memory card compartment: "Laser class 2" and "Class II LASER PRODUCT".

Products with an integrated distancer of laser class 3R resp. IIIa

The product is a Class 3R laser product in accordance with:

- IEC 60825-1:1993 + A1:1997 + A2:2001 : "Radiation safety of laser products"

The product is a Class IIIa laser product in accordance with:

- FDA 21CFR Ch.I §1040 : 1988 (US Department of Health and Human Service, Code of Federal Regulations).

Class 3R / IIIa laser products:
Direct intrabeam viewing is always hazardous. Avoid direct eye exposure. The accessible emission limit is within five times the accessible emission limits of Class 2 / II in the wavelength range from 400nm to 700nm.

WARNING:
Direct intrabeam viewing is always hazardous.

Precautions:

Do not stare into the beam or direct it towards other people unnecessarily. These measures are also valid for the reflected beam.

WARNING:
Looking directly into the reflected laser beam could be dangerous to the eyes when the laser beam is aimed at areas that reflect like a mirror or emit reflections unexpectedly (e.g. prisms, mirrors, metallic surfaces, windows).

Precautions:

Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections. Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on (in Laserpointer or distance measurement mode). Aiming at prisms is only permitted when looking through the telescope.

WARNING:
The use of Laser Class 3R / IIIa equipment can be dangerous.

Precautions:

To counteract hazards, it is essential for every user to respect the safety precautions and control measures specified in the standard IEC 60825-1: 1993 + A1:1997 + A2:2001, within the hazard distance *). Pay particular attention to Section Three "User's Guide".

There follows here below an interpretation of the main points in the relevant section of the standard quoted.

Class 3R laser products used on construction sites and outdoors (surveying, alignment, levelling):

a) Only qualified and trained persons should be assigned to install, adjust and operate the laser equipment.

b) Areas in which these lasers are used should be posted with an appropriate laser warning sign.

c) Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

d) The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path extends beyond the limit (hazard distance *)) of the area in which the presence and activities of personnel are monitored for reasons of protection from laser radiation.

e) The laser beam path should be located well above or below eye level wherever practicable.

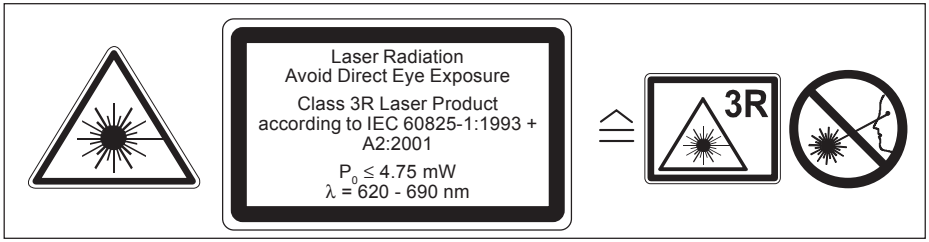
f) When not in use the laser product should be stored in a location where unauthorized personnel cannot gain access.

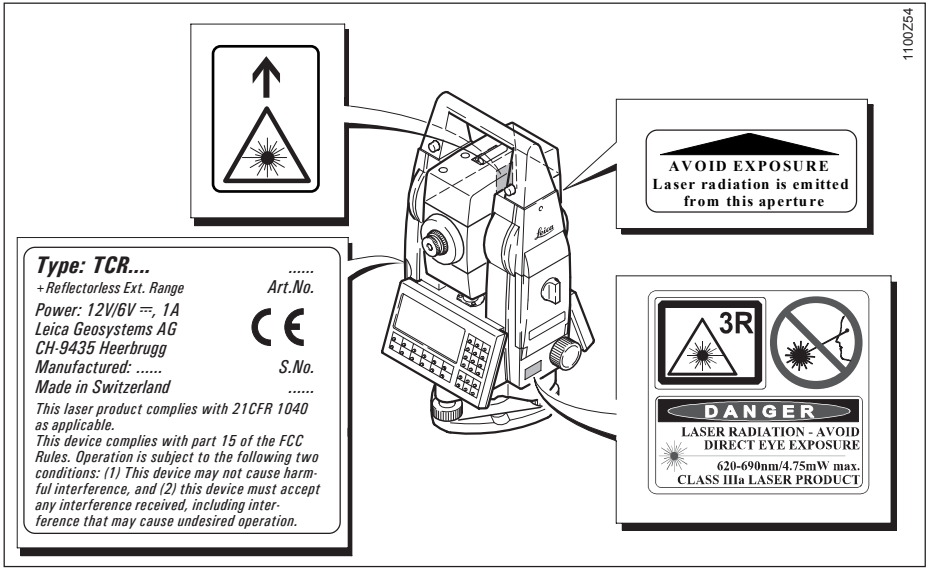
g) Precautions should be taken to ensure that the laser beam is not unintentionally directed at mirror-like (specular) surfaces (e.g. mirrors, metal surfaces, windows). But, more importantly, at flat or concave mirror-like surfaces.

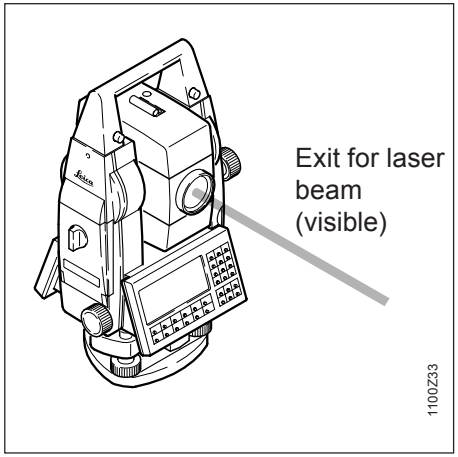
*) The hazard distance is the distance from the laser at which beam irradiance or radiant exposure equals the maximum permissible value to which personnel may be exposed without being exposed to a health risk.

Products with an integrated distancer of laser class 3R resp. IIIa this hazard distance is 1000m (3300ft). At this distance, the laser beam rates as Class 1 (= direct intrabeam viewing is not hazardous).

Labelling




1100Z54
Type: TCR....
+Reflectorless Ext. Range
Art.No.
Power: 12V/6V ⎓, 1A
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: .....
S.No.
Made in Switzerland
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
AVOID EXPOSURE
Laser radiation is emitted from this aperture
3R
DANGER
LASER RADIATION - AVOID DIRECT EYE EXPOSURE
620-690nm/4.75mW max.
CLASS IIIa LASER PRODUCT



Beam divergence:	0.15 x 0.35 mrad
Pulse duration:	800 ps
Maximum radiant power:	4.75 mW
Maximum radiant power per pulse:	59.4 mW
Measurement uncertainty:	± 5%

Products with an integrated distancer of laser class 2 resp. II

The product is a Class 2 laser product in accordance with:

- IEC 60825-1:1993 "Radiation safety of laser products"
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

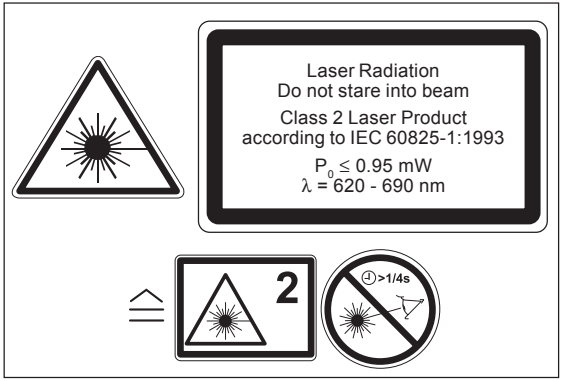
The product is a Class II laser product in accordance with:

- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

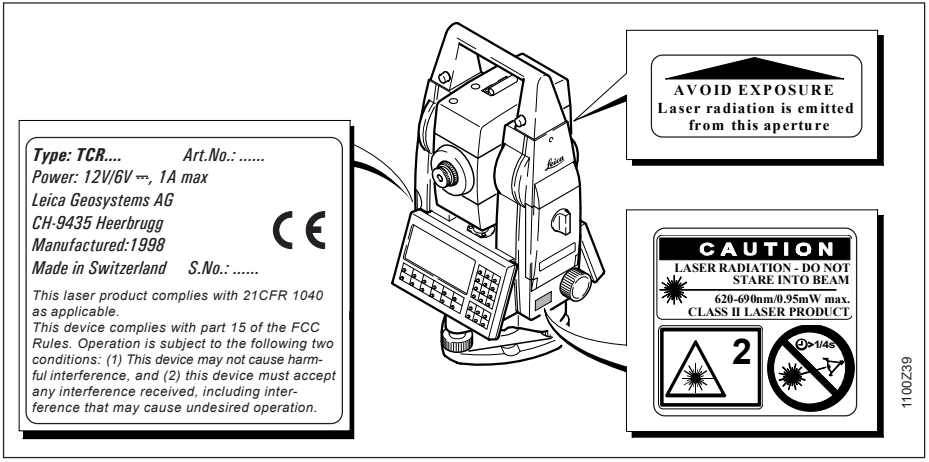
Class 2/II laser products:
Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

WARNING:
It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

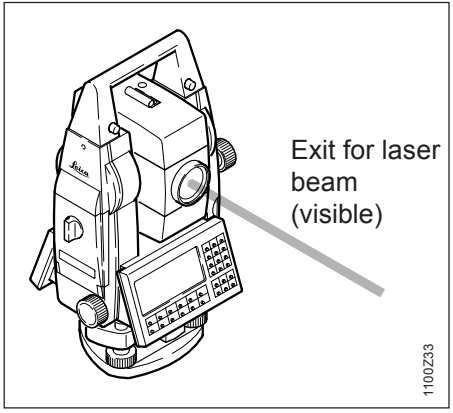
Precautions:
Do not look directly into the beam with optical equipment.



Labelling


Type: TCR.... Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland S.No.: .....
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
AVOID EXPOSURE
Laser radiation is emitted from this aperture
CAUTION
LASER RADIATION - DO NOT STARE INTO BEAM
620-690nm/0.95mW max.
CLASS II LASER PRODUCT
2
>1/4s
1100Z39

Beam divergence:	0.15 x 0.35 mrad
Pulse duration:	800 ps
Maximum radiant power:	0.95 mW
Maximum radiant power per pulse:	12 mW
Measurement uncertainty:	± 5%



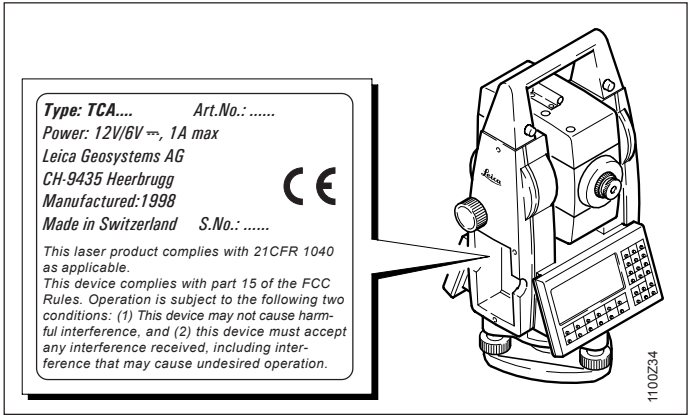
The integrated automatic target recognition produces an invisible laser beam which emerges coaxially from the telescope objective.

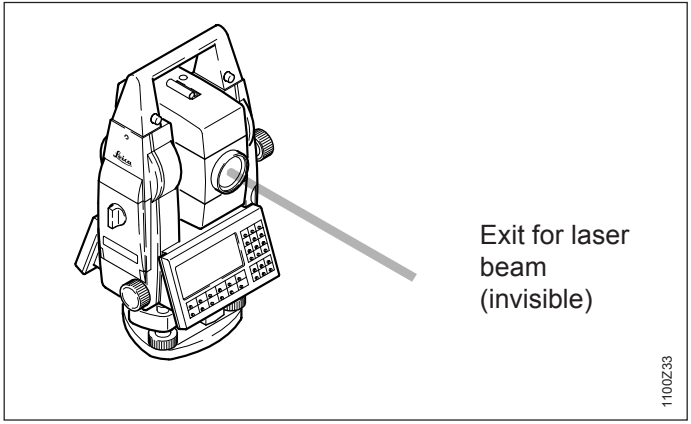
The product is a Class 1 laser product in accordance with:
- IEC 60825-1:1993 "Radiation safety of laser products".
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

The product is a Class I laser product in accordance with:
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 1/I laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

Beam divergence:	26.2 mrad
Pulse duration:	9.8 ms
Maximum radiant power:	0.76 mW
Maximum radiant power per pulse:	1.52 mW
Measurement uncertainty:	± 5%


Type: TCA.... Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland S.No.: .....
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
1100Z34


Exit for laser beam (invisible)
1100Z33

The integrated PowerSearch generates an invisible laser from the lower front of the telescope.

The product is a Class 1 laser product in accordance with:
- IEC 60825-1:1993 + A1:1997 + A2:2001 "Radiation safety of laser products".
- EN 60825-1:1994 + A11:1996 + A2:2001 "Radiation safety of laser products".

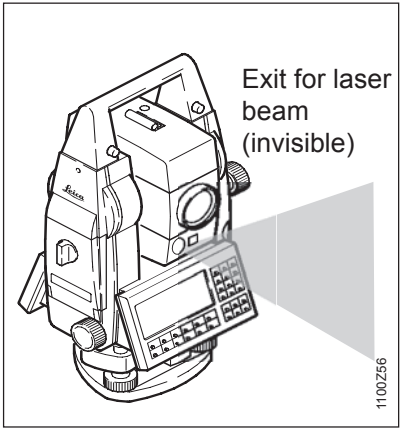
The product is a Class I laser product in accordance with:
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations).

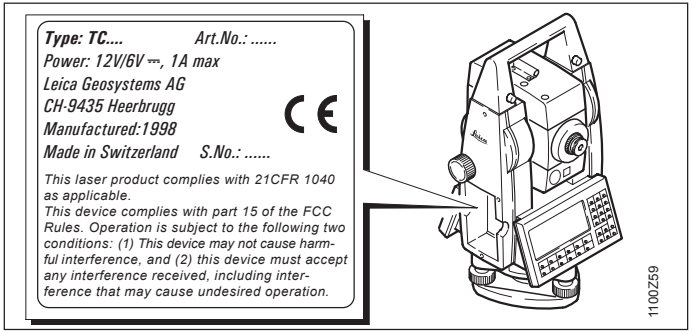
Class 1/I laser products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

Class 1 Laser Product

according to IEC 60825-1:1993 + A1:1997 + A2:2001

Beam divergence:	0.4x700 mrad
Pulse duration:	80 ns
Max. radiant power:	1.1 mW
Max. radiant power per pulse:	5.3 W
Measurement uncertainty:	± 5%




Type: TC.... Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland S.No.: .....
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
1100Z59

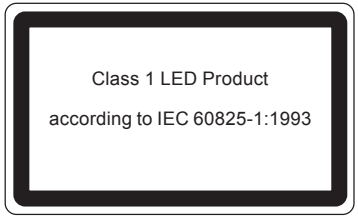
The integrated guide light produces a visible LED beam from the upper front side of the telescope.
The product is a Class 1 LED product *) in accordance with:

- IEC 60825-1:1993 "Radiation safety of laser products"
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

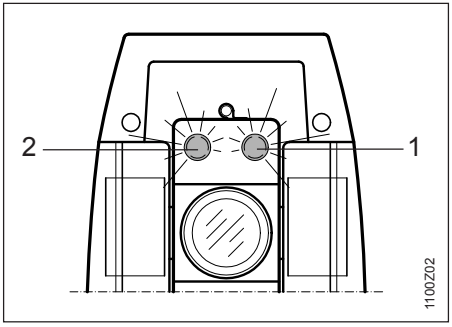
*) Within the specified working range of > 5 m (> 16 ft).

Class 1 LED products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with the instructions.

CAUTION:
Use the guide light only within the specified working range of > 5 m (> 16 ft) from the telescope.



Flashing LED	yellow	red
Beam divergence:	2.4 °	2.4 °
Pulse duration:	2 x 105 ms	1 x 105 ms
Maximum radiant power:	0.28 mW	0.47 mW
Maximum radiant power per pulse:	0.75 mW	2.5 mW
Measurement uncertainty:	± 5 %	± 5 %



1 Exit for flashing red LED
2 Exit for flashing yellow LED

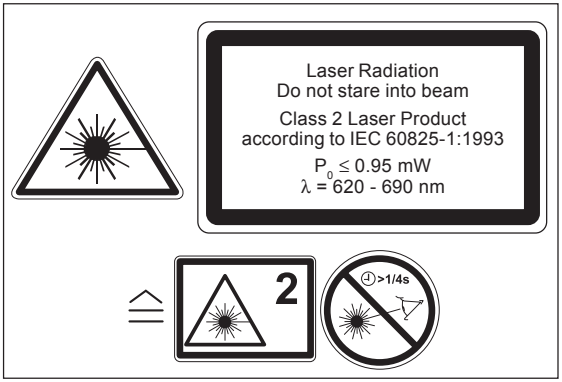
The laser plummet built into the total station produces a visible infrared beam which emerges from the bottom of the instrument.

The product is a Class 2 laser product in accordance with:
- IEC 60825-1:1993 "Radiation safety of laser products"
- EN 60825-1:1994 + A11:1996 "Radiation safety of laser products"

The product is a Class II laser product in accordance with:
- FDA 21CFR Ch.I §1040: 1988 (US Department of Health and Human Service, Code of Federal Regulations)

Class 2/II laser products: Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

Labelling

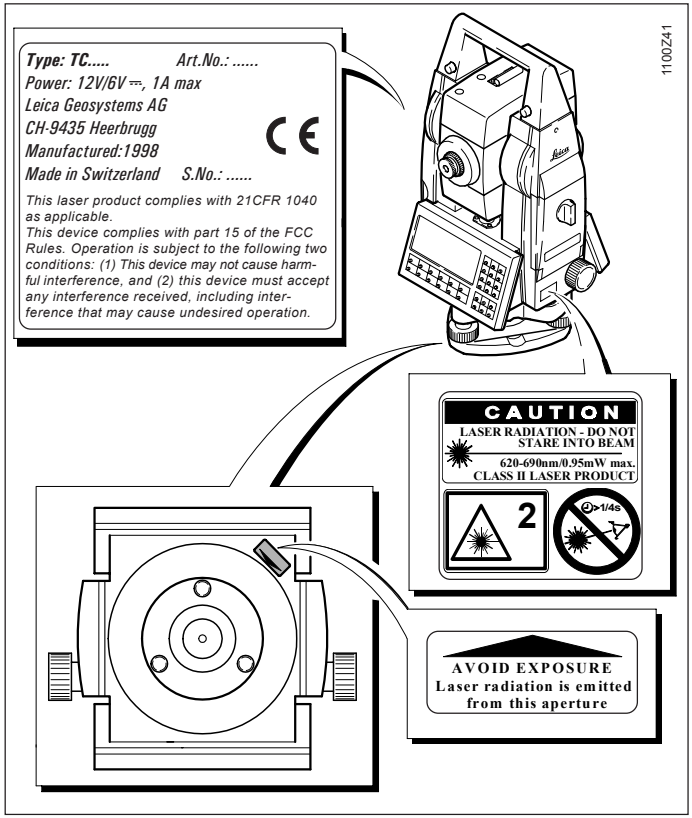


WARNING:

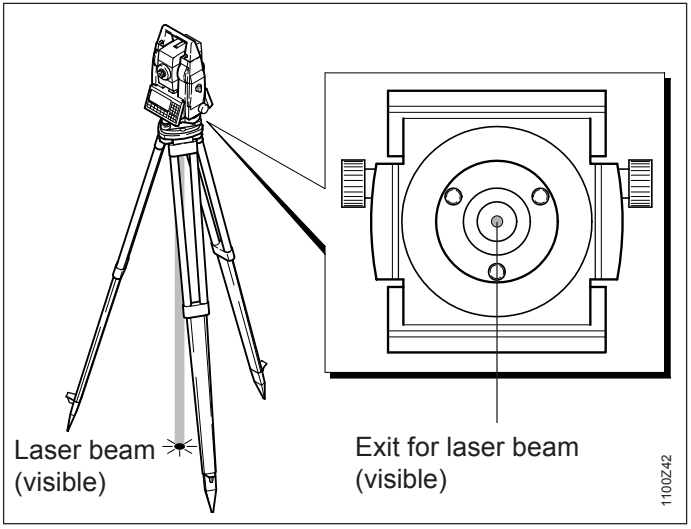
It can be dangerous to look into the beam with optical equipment (e.g. binoculars, telescopes)

Precautions:

Do not look directly into the beam with optical equipment.


Type: TC.....
Art.No.: .....
Power: 12V/6V ⎓, 1A max
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured:1998
Made in Switzerland
S.No.: .....
This laser product complies with 21CFR 1040 as applicable.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
CAUTION
LASER RADIATION - DO NOT STARE INTO BEAM
620-690nm/0.95mW max.
CLASS II LASER PRODUCT
2
>1/4s
AVOID EXPOSURE
Laser radiation is emitted from this aperture
1100Z41

Beam divergence:	0.16 x 0.6 mrad
Pulse duration:	c.w.
Maximum radiant power:	0.95 mW
Maximum radiant power per pulse:	n/a
Measurement uncertainty:	± 5%



The term "electromagnetic compatibility" is taken to mean the capability of the total station to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

WARNING:
Electromagnetic radiation can cause disturbances in other equipment.

Although the total stations meet the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

CAUTION:
There is a risk that disturbances may be caused in other equipment if the total station is used in conjunction with accessories from other manufacturers, e.g. field computers, personal computers, walkie-talkies, non-standard cables, external batteries.

Precautions:
Use only the equipment and accessories recommended by Leica Geosystems. When combined with total stations, they meet the strict requirements stipulated by the guidelines and standards. When using computers and walkie-talkies, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

CAUTION:

Disturbances caused by electromagnetic radiation can result in the tolerance limits for measurements being exceeded.

Although the total stations meet the strict regulations and standards which are in force in this connection, Leica Geosystems cannot completely exclude the possibility that the total station may be disturbed by very intense electromagnetic radiation, e.g. near radio transmitters, walkie-talkies, diesel generators, power cables.

Check the plausibility of results obtained under these conditions.

WARNING:

If the total station is operated with connecting cables attached at only one of their two ends (e.g. external supply cables, interface cables), the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other instruments may be impaired.

Precautions:

While the total station is in use, connecting cables (e.g. instrument to external battery, instrument to computer) must be connected at both ends.

WARNING:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

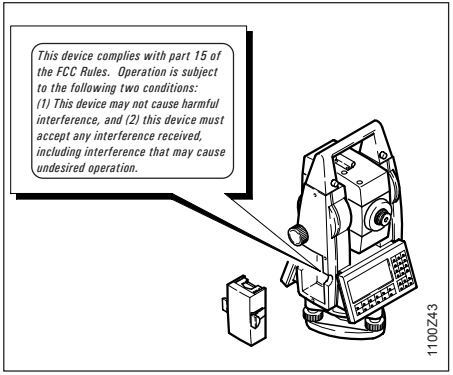
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING:

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Product labeling:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.


This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
1100Z43

Distance measurement (infrared)

- Type: infrared
- Carrier wave: 0.780 µm
- Measuring system: special frequency system basis 100 MHz = 1.5 m
- EDM type: coaxial
- Display (least count): 1 mm

EDM measuring programm	Accuracy **	Time per measurement
Standard measurement	2 mm + 2 ppm	1.0 sec.
Fast measurement	5 mm + 2 ppm	0.5 sec.
Normal tracking	5 mm + 2 ppm	0.3 sec.
Rapid tracking	10 mm + 2 ppm	< 0.15 sec.
Averaging	2 mm + 2 ppm	-----

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

Prism constants (additive constants)

- Standard prism: 0.0 mm
- Mini prism: +17.5 mm
- 360° Reflector: +23.1 mm
- 360° Mini prism: +30.0 mm
- Reflector tape: +34.4 mm

	Range: (normal and rapid measurement)				
	Standard prism	3 prisms (GPH3)	360° reflector	Reflector tape 60mm x 60mm	Mini prism
1	1800 m (6000 ft)	2300 m (7500 ft)	800 m (2600 ft)	150 m (500 ft)	800 m (2600 ft)
2	3000 m (10000 ft)	4500 m (14700 ft)	1500 m (5000 ft)	250 m (800 ft)	1200 m (4000 ft)
3	3500 m (12000 ft)	5400 m (17700 ft)	2000 m (7000 ft)	250 m (800 ft)	2000 m (7000 ft)

Atmospheric conditions:

1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

Shortest measuring distance

- Standard prism: 0.2 m
- Mini prism: 0.2 m
- 360° Reflector: 1.5 m
- 360° Mini prism: 1.5 m
- Reflector tape: 1.5 m

Measurements can be made to reflector tapes over the entire range without external ancillary optics (GDV3).

Distance measurement (long range, or without reflector)

- Type: visible red laser
- Carrier wave: 0.670µm
- Measuring system: special frequency system basis 100 MHz = 1.5 m
- EDM type: coaxial
- Display (least count): 1mm
- Laser dot Size: ~ 7mm x 14mm at 20m ~ 10mm x 20mm at 50m

Standard measuring	Accuracy **	Meas. time
Reflector-free up to 30 m	3 mm + 2 ppm	≤ 3.0 sec
Reflector-free above 30 m	3 mm + 2 ppm	3.0 sec +1.0 sec/10m
Long Range	5 mm + 2 pmm	typ. 1.5 sec max. 8 sec

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

Distance measurement (without reflector)

- Range of measurement: 1.5 m to 80 m (to target plate, part.no. 710333)
- Display unambiguous: to 760 m
- Prism constant (additive constant): + 34.4 mm

	Range (without reflector)	
Atmospheric conditions	No reflector (white target)*	No reflector (grey, albedo 0.25)
4	60 m (200 ft)	30 m (100 ft)
5	80 m (260 ft)	50 m (160 ft)
6	80 m (260 ft)	50 m (160 ft)

* Kodak Grey Card used with exposure meter for reflected light

4) Object in strong sunlight, severe heat shimmer
5) Object in shade, or sky overcast
6) Underground, night and twilight

Distance measurement (long range)

- Range of measurement: from 1000m up
- Display unambiguous: to 12 km

	Range (long range)	
Atmospheric conditions	Standard prism	Three prisms (GPH3)
1	1500 m (5000 ft)	2000 m (7000 ft)
2	5000 m (16000 ft)	7000 m (23000 ft)
3	> 5000 m (16000 ft)	> 9000 m (30000 ft)

1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

Distance measurement Extended Range (long range, or without reflector)

- Type: visible red laser
- Carrier wave: 0.670 µm
- Measuring system: special frequency system basis 100 MHz ^= 1.5 m
- EDM type: coaxial
- Display (least count): 1 mm
- Laser dot Size: ~ 7mm x 14mm / 20m
  ~ 15mm x 30mm / 100m
  ~ 30mm x 60mm / 200m

Standard measuring	Accuracy **	Meas. time
Reflector-free	3 mm + 2 ppm	typ. 3 - 6 sec max. 12 sec
Long Range	5 mm + 2 pmm	typ. 2.5 sec max. 8 sec

** Beam interruptions, severe heat shimmer and moving objects within the beam path can result in deviations of the specified accuracy.)

Distance measurement Extended Range (without reflector)

- Range of measurement: 1.5 m to 300 m (to target plate, part.no. 710333)
- Display unambiguous: to 760 m
- Prism constant (additive constant): + 34.4 mm

	Range (without reflector)	
Atmospheric conditions	No reflector (white target)*	No reflector (grey, albedo 0.25)
4	140 m (460 ft)	70 m (230 ft)
5	170 m (560 ft)	100 m (330 ft)
6	>170 m (560 ft)	> 100 m (330 ft)

* Kodak Grey Card used with exposure meter for reflected light
4) Object in strong sunlight, severe heat shimmer
5) Object in shade, or sky overcast
6) Underground, night and twilight

Distance measurement Extended Range (long range)

- Range of measurement: from 1000 m
- Display unambiguous: up to 12 km

	Range (long range)	
Atmospheric conditions	Standard prism	Reflector Tape (60 x 60 mm)
1	2200 m (7200 ft)	600 m (2000 ft)
2	7500 m (24600 ft)	1000 m (3300 ft)
3	> 10000 m (33000 ft)	1300 m (4200 ft)

1) Strong haze, visibility 5km; or strong sunlight, severe heat shimmer
2) Light haze, visibility about 20km; or moderate sunlight, slight heat shimmer
3) Overcast, no haze, visibility about 40km; no heat shimmer

Angle measurement

Types	Accuracy Hz, V (ISO 17123-3)	Display (least count)
1101	1.5" (0.5 mgon)	1" (0.1 mgon
1102	2" (0.6 mgon)	1" (0.1 mgon)
1103	3" (1.0 mgon)	1" (0.5 mgon)
1105	5" (1.5 mgon)	1" (0.5 mgon)

- Options / cimal: 360° ' ", 360dec., 400 gon, V%, 6400 mil
- method: absolute, continuous, diametral

Telescope

- Magnification: 30x
- Image: upright
- Clear objective diameter: 40 mm
- Shortest sighting distance: 1.7 m (5.6 ft)
- Focusing: only coarse
- Field of view: 1°30' (1.66gon)
- Telescope field of view at 100m 2.7 m
- Transit: fully

Compensator

- Type: liquid
- No. of axes: dual (switchable on/off)
- Setting range 4' (0.07 gon)
- Setting accuracy
  - Type 1101 0.5" (0.2 mgon)
  - Type 1102 0.5" (0.2 mgon)
  - Type 1103 1" (0.3 mgon)
  - Type 1105 1.5" (0.5 mgon)

Sensitivity of bubble or of level

- Bull's-eye bubble: 6'/2 mm
- Plate level: none
- Electronic bubble: resolution 2"

Tilting-axis height

- above tribrach: 196mm

Optical plummet

- Location: in tribrach
- Magnification: 2x, focusable

Laser plummet

- Location: in vertical axis of instrument
- Accuracy: Deviation from plumbline 1.5 mm (2 sigma) at 1.5 m instrument height
- Diameter of laser point 2.5 mm / 1.5 m

Battery

- Type: Nickel-metal hydride (NiMH)
- Nominal voltage: 6 V
- Capacitance
  GEB121 (Standard): 3.6 Ah
  GEB111 (Optional): 1.8 Ah
- Location: in support
- Power Supply
  If an external cable is used, then for a nominal voltage of 12V (DC) the voltage range must lie between 11.5V and 14V.

	No. of measure-ment (angle and distance)
TC/TCR	600
TCM/TCRM/ TCA/TCRA	400

Keyboard and display

Keyboard with 30 keys, six of them function keys and 12 of them alphanumeric keys.

Position	in both faces (face 2 as option)
Alphanumeric characters	maximum 256
Character sets	Extended ASCII character set as standard. Additional character set optionally loadable
Type of display	LCD
Size of display	8 rows x 32 characters
Graphics capable	yes, 64 x 256 pixels

Weight

Type	Weight
TC/TCR	4.7 kg (10.4 lbs)
TCM/TCRM/ TCA/TCRA	4.9 kg (10.8 lbs)
Tribrach	0.8 kg (1.7 lbs)
Battery module	0.4 kg (0.8lbs)

Durability/ Temperature range

- Measuring: -20° to +50° C (-4° to +122° F)
- Storage: -40° to +70° C (-40° to +158° F)

Other features

- Programmability: Yes
- Alignment aid: as option

Automatic corrections

- Line-of-sight error Yes
- Vertical-index error Yes
  Tilting-axis error Yes
- Standing-axis tilt Yes
- Earth curvature Yes
- Refraction Yes
- Circle eccentricity Yes

Recording

- RS232 interface Yes
- Internal memory: Yes
  Total capacity: 5 Mbytes
  Capacity available for programs and texts: ~ 1.7 Mbytes
- Plug-in data storage module (SRAM): PC card
  for data: Yes
  Capacity: 0.5 / 2 / 4 Mbytes
  No. of data blocks 4500 to 36000
- Plug-in data storage module (ATA Flash): PC card
  for data: Yes
  Capacity: 4 / 10 Mbytes
  No. of data blocks 36000 to 90 000

Tangent screws

- Number Hz/V 1 Hz, 1V
- Movement endless

Other drives

- TCM, TCA motorized

- Working range: 5m - 150m (15 ft - 500 ft)
- Positioning range at 100 m: 50mm
- Left/right indication: Yes
- TCA/TCRA instruments: EGL2
- All other instruments: EGL3

Positioning accuracy
(TCA1102 / Standard prism, static, ATR single measurement)

Distance	Accuracy	Measuring time
to 300 m	3 mm	3sec
> 300 m	*	3 - 4

* in accordance with angle-measuring accuracy

Prism use

• Standard prisms	Yes
• Mini prism	Yes
• 360° reflector	Yes
• 360° Mini prism	Yes
• Reflector tape	Yes

Special active prisms are not required.

Recognition method

• Video techniques:	Yes
• EDM techniques:	No

Range
(under average conditions without interruption of view)

	ATR mode	LOCK mode
Standard prism	1000 m (3300 ft)	800 m (2600 ft)
Mini prism	500 m (1600 ft)	400 m (1300 ft)
360° reflector	600 m (2000 ft)	500 m (1600 ft)
360° Mini prism	350 m (1150 ft)	300 m (1000 ft)
Reflector tape 60x60	65 m (200 ft)	not qualified

Shortest measuring distance (360°Refl.)

• ATR	1.5 m
• LOCK	5 m

Rotation and speed

Positioning	to 50 gon/sec

Follow a moving prism
(LOCK mode)

Tracking ?	Distance	Max. tang. speed
No	at 20 m	5 m/sec.
No	at 100 m	25 m/sec.
Yes	at 20 m	3.5 m/sec.
Yes	at 100 m	18 m/sec.
Tracking ?	**Distance**	**Max. radial speed**
Yes	0 to max. distance	4 m/sec.

Searching

Typical search time in telescopic field of view	Normal measurement = 2.5 sec + 1 sec positioning
Full scope of search	1°30' (1.66 gon)
Scope of search using remote control	18° (20 gon)
Interrupted viewing	Yes, briefly

Usable prisms

• Standard prisms	yes
• Mini prisms	yes
• 360º Reflector	yes
• 360º Mini prism	not recommended
• Reflector tape	no

No special active prisms are required.

Range*

(under average conditions without interruption of view)

Standard prism	200 m
360º prism**	200 m
Mini prism	100 m

* Measurements at the vertical limits of the swath or under unfavorable atmospheric conditions may reduce the maximum range.

** optimally aligned to the instrument.

Target recognition

Shortest measuring distance	5 m
Rotation speed	up to 50 gon/sec
Definable search area	yes
Search area	400 gon x 40 gon
Typical search time	<10 sec.

See "Reference handbook TPS1100 programs".

Integrated programs

Target eccentricity
Manual coordinate input
Single-point orientation
Data converter (ASCII /GSI)

Standard programs

Free station
Orientation and height transfer
Resection
Stakeout
Tie distance
Remote height

Survey programs

Area	+
COGO	+
Hidden point	+
Local Resection	+
Reference Line	+
Road Plus /File editor	+
Sets of angles	+
Traverse	+
Auto Record	+
DTM stakeout	+
Face scan	+
Programmable	+

with GeoBasic language. No DOS required in total station.

Key:

+ available as option

TPS Advanced program package

All standard programs,
Area,
COGO,
Local Resection,
Reference Line,
Sets of angles,
Traverse,

TPS Expert program package

All standard programs,
TPS Advanced program package,
DTM stakeout,
Auto Record,
Hidden point,
Reference line,
Face scan,

By entering a scale correction, reductions proportional to distance (e.g. atmospheric correction, reduction to mean sea level, or projection distortion) can be taken into account.

The distance displayed is correct only if the scale correction in ppm (mm/km) which has been entered corresponds to the atmospheric conditions prevailing at the time of the measurement.

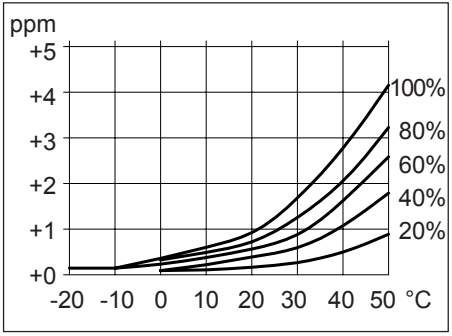
The atmospheric correction includes adjustments for air pressure, air temperature and relative humidity.

If, for highest-precision distance measurements, the atmospheric correction should be determined with an accuracy of 1 ppm, the following parameters must be redetermined: Air temperature to 1°C; air pressure to 3 millibars; relative humidity to 20%.

It is usually sufficient to take the atmospheric correction from the diagram and to enter this value with the keyboard.

The air humidity influences the distance measurement if the climate is extremely hot and damp.

For high-precision measurements, the relative humidity must be measured and entered along with the air pressure and the temperature.



Air-humidity correction in mm/km (ppm), air temperature in °C, relative humidity in %

The index n for the infrared EDM (carrier wave 780nm) = 1.0002830. For the visible red laser (carrier wave 670nm), n = 1.0002859.

The index n is calculated from the formula of Barrel and Sears, and is valid for air pressure p = 1013.25 mbar, for air temperature t = 12°C and for relative air humidity h = 60%.

Formula for infrared EDM:

$$\Delta D_1 = 283.04 - \left[\frac{0.29195 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x}\right]$$

Formula for visible red laser:

$$\Delta D_1 = 285.92 - \left[\frac{0.29492 \cdot p}{(1 + \alpha \cdot t)} - \frac{4.126 \cdot 10^{-4} \cdot h}{(1 + \alpha \cdot t)} \cdot 10^{x}\right]$$

ΔD_1 = atmospheric correction [ppm]

p = air pressure [mbar]
t = air temperature [°C]
h = relative humidity [%]
α = 1 / 273.16

$$x = \frac{7.5\ t}{237.3 + t} + 0.7857$$

If the basic value of 60% relative humidity as used by the EDM is retained, the maximum possible error in the calculated atmospheric correction will be 2 ppm (2 mm / km).

Reduction to mean sea level ΔD_2

The values for ΔD_2 are always negative and are derived from the following formula:

$$\Delta D_2 = -\frac{H}{R} \cdot 10^3$$

ΔD_2 = reduction to mean sea level [ppm]
H = height of EDM above sea level [m]
R = 6378 km

Projection distortion ΔD_3

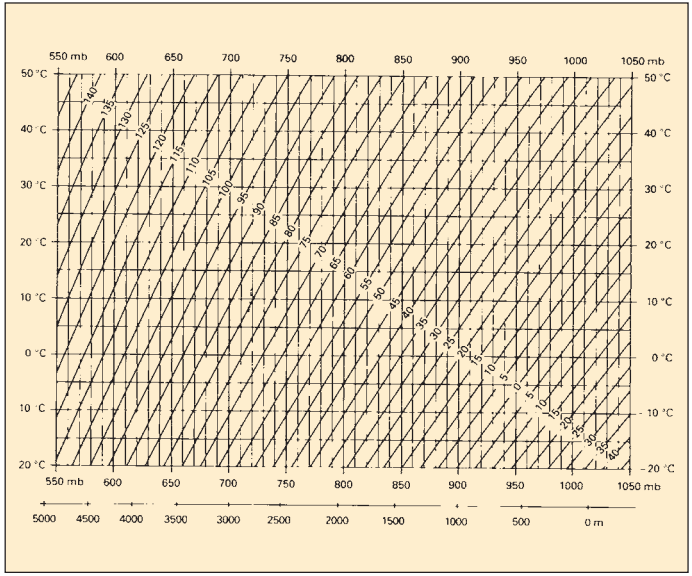
The magnitude of the projection distortion is in accordance with the projection system used in a particular country, for which official tables are generally available. The following formula is valid for cylindrical projections such as that of Gauss-Krüger:

$$\Delta D_3 = \frac{X^2}{2R^2} \cdot 10^6$$

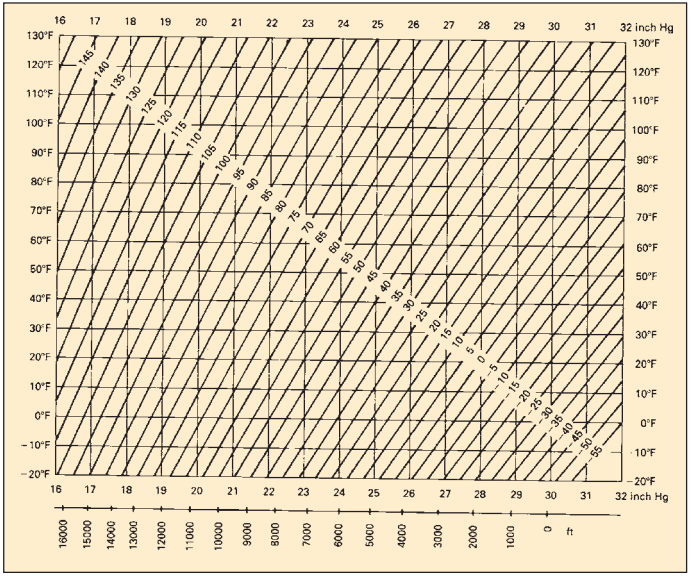
ΔD_3 = projection distortion [ppm]
X = northing, distance from projection zero line with the scale factor 1 [km]
R = 6378 km

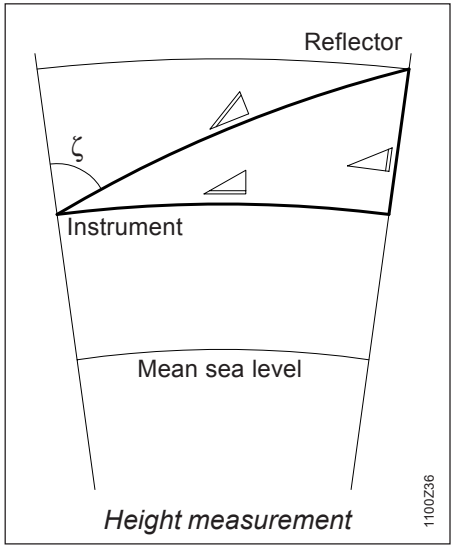
In countries where the scale factor is not unity, this formula cannot be directly applied.

Atmospheric correction in ppm with °C, mb, H (metres) at 60% relative humidity



Atmospheric correction in ppm with °F, inch Hg, H (feet) at 60% relative humidity





Height measurement

The instrument calculates slope distance, horizontal distance and height difference in accordance with the following formula. Earth curvature and mean refraction coefficient (k = 0.13) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector height.

$$\text{slope} = D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$$

slope = displayed slope distance [m]
D_0 = uncorrected distance [m]
ppm = scale correction [mm/km]
mm = prism constant [mm]

$$\text{height difference} = Y - A \cdot X \cdot Y$$

$$\text{horizontal distance} = X + B \cdot Y^2$$

horizontal distance = horizontal distance [m]
height difference = height difference [m]
$Y = \text{height difference} \cdot |\sin \zeta|$
$X = \text{horizontal distance} \cdot \cos \zeta$
ζ = vertical-circle reading

$$A = \frac{1 - k/2}{R} = 1.47 \cdot 10^{-7} \ [m^{-1}]$$

$$B = \frac{1 - k}{2R} = 6.83 \cdot 10^{-8} \ [m^{-1}]$$

k = 0.13
$R = 6.37 \cdot 10^6$ m

In the distance-measuring program "Averaging", the following values are displayed:

D = slope distance as arithmetic mean of all measurements
s = standard deviation of a single measurement
n = number of measurements

These values are calculated as follows:

$$\bar{D} = \frac{1}{n} \cdot \sum_{i=1}^{n} D_i$$

Σ = sum
D_i = single measurement

$$s = \sqrt{\frac{\sum_{i=1}^{n} (D_i - \bar{D})^2}{n-1}} = \sqrt{\frac{\sum_{i=1}^{n} D_i^2 - \frac{(\sum D_i)^2}{n}}{n-1}}$$

The standard deviation $S_{\bar{D}}$ of the arithmetic mean of the distance can be calculated as follows:

$$S_{\bar{D}} = \frac{s}{\sqrt{n}}$$

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Leica Geosystems AG, Heerbrugg, Switzerland has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

Total Quality Management - Our commitment to total customer satisfaction

Ask your local Leica Geosystems agent for more information about our TQM program.

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TPS1100 Professional Series

System Field Manual

English

Version 2.2

Leica Geosystems

The quick way to start with the TPS1100.

To use the equipment in the permitted manner, please refer to the detailed safety instructions in the User Manual.

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How to use this Manual

This field manual gives step by step introductions for the use of the TPS1100 system software. It has two objectives:

1. To introduce a novice user to the basic operation concepts and the practical use of a TPS1100 totalstation. We recommend that new users have the instrument set up while they read through this manual.

2. To serve as handy field reference for the experienced user during his daily work. To have the manual at your hands when you need it we recommend to store it in the appropriate slot in the instrument transportation case.

Symbols used in the sequence of operation

Press fixed key PROG.

User input is necessary.

Press function key F1 to activate the function ALL.

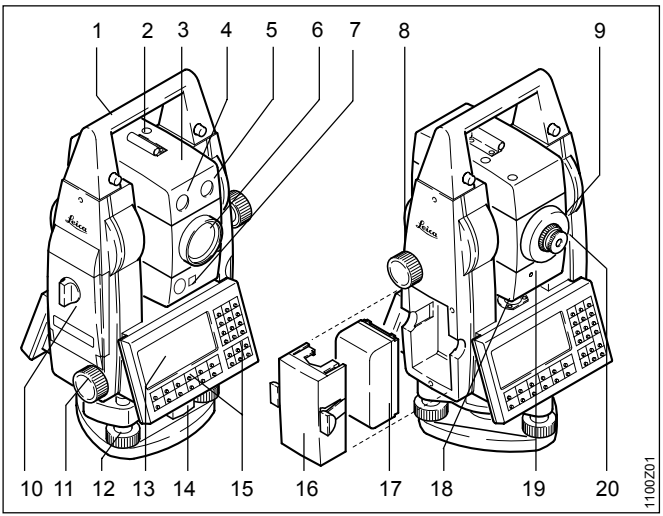
Repeat operation.

Other Symbols

Important information and tips.

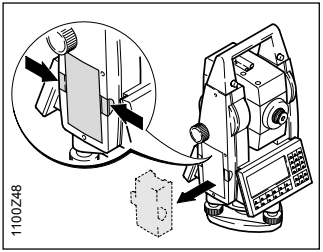
Optional function, not part of the standard sequence of operation.
Here: Press function key labelled "NEW-J".

Instrument description

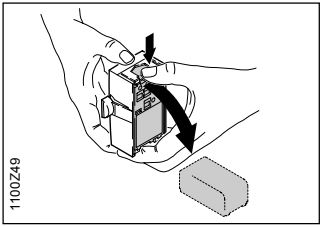


1 Carrying handle
2 Optical sight
3 Telescope with integrated EDM, ATR, EGL and PowerSearch
4 EGL flashing diode (yellow)
5 EGL flashing diode (red)
6 Coaxial optics for angle- and distance measurement; Exit port of red laser beam (only R-model instruments)
7 PowerSearch
8 Vertical drive screw
9 Focusing ring
10 Memory card housing
11 Horizontal drive screw
12 Footscrew (tribrach)
13 Display
14 Tribrach securing knob
15 Keyboard
16 Batteryholder
17 Battery
18 Bull's-eye bubble
19 Laser emission indicator lamp (yellow) - only XR-instruments
20 Exchangeable eyepiece

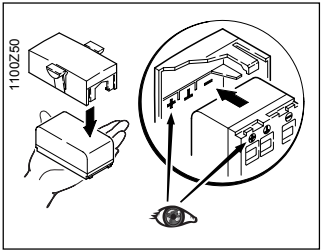
Inserting / replacing battery



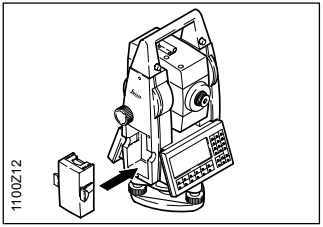
1. Remove battery holder.



2. Remove battery and replace.



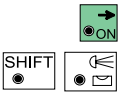
3. Insert battery into battery holder.

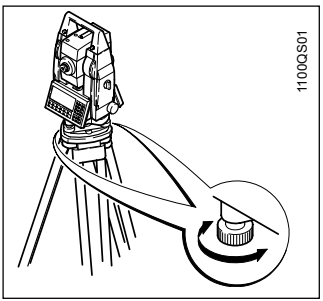


4. Insert battery holder into instrument.

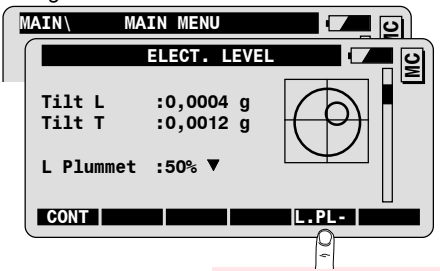
Insert battery correctly (note pole markings on the inside of the battery cover). Check and insert battery holder true to side into the housing.

Center and level





To center and level your instrument, activate the electronic level dialog.



Laser Plummet: ON/OFF

1. Center the instrument, using the laser plummet: a red laser dot is projected on the ground.
2. Level up using the footscrews.

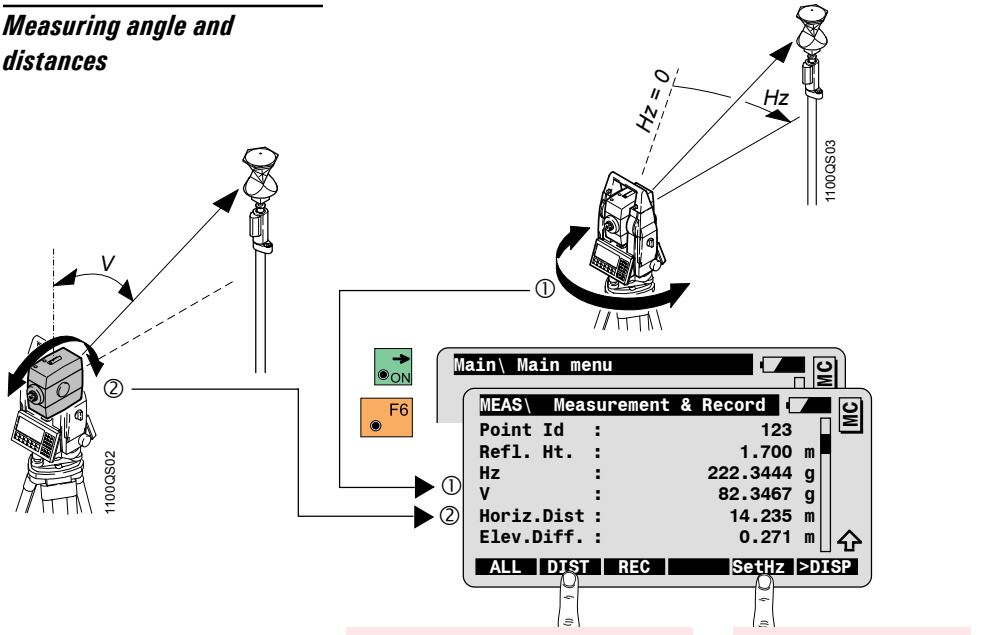
With the electronic level, you don't need to turn the instrument through 90°/180°.

Repeat 1. and 2. until instrument is centered and leveled.

CONT F1

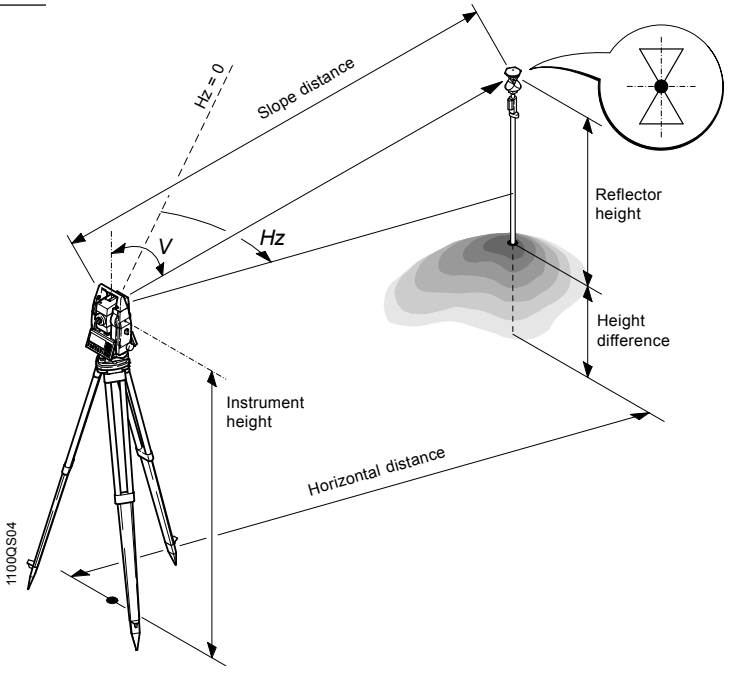
To continue.

Measuring angle and distances

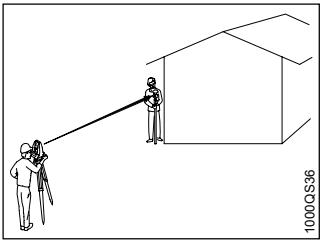


Elements of measurement

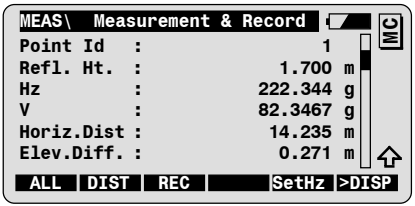
Hz = Horizontal angle
V = Vertical angle



Measuring angles and distances separately



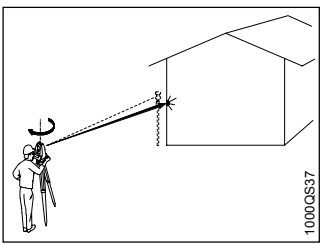
Measuring to inaccessible points.

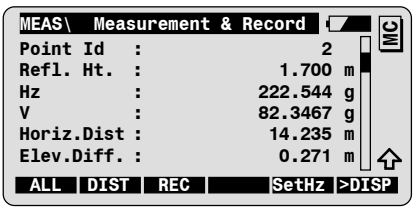


DIST ● *F2* Triggers distance measurement.

The vertical angle is retained after the distance measurement.

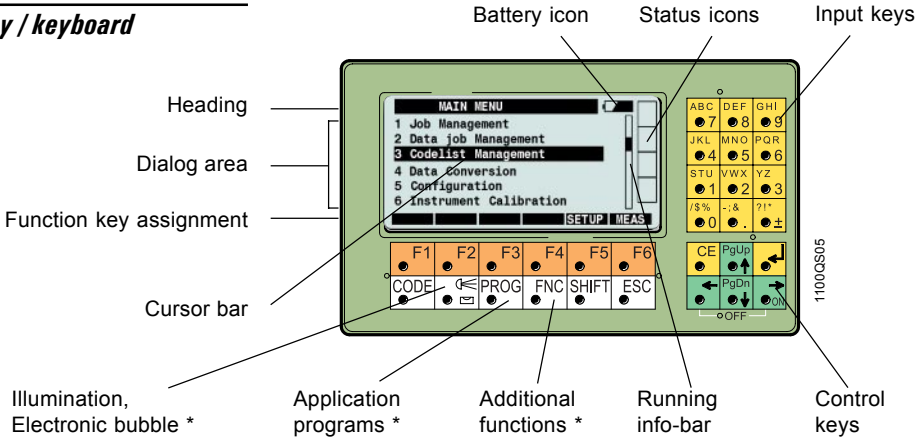
You can now determine the Hz angle of the inaccessible point.





REC ● *F3* Record the displayed measurements.

Display / keyboard

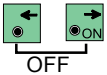


* => always accessible !

The "running info-bar" indicates that additional information is available in the active dialog.

ON / OFF

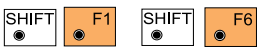
To switch the instrument ON.



To switch the instrument OFF, first press both keys simultaneously and then press F6.

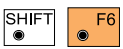
Function keys

Dialog dependent function keys. Assignment is indicated in reverse mode in the bottom line of the display.



Second level of function keys. Pressing on SHIFT changes the assignment of the keys.

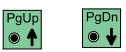
Quit / Escape



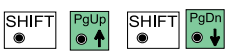
To quit the active function or program. Available in all dialogs.

To return to previous display. Values altered in dialog are not accepted.

Control keys



To scroll through the dialog line by line and to set the cursor bar.



To display the previous or next page of the active dialog.

Fixed key concept

The white keys of the TPS1100 keyboard are fixed keys. Most of them are accessible anytime during operation.

Standard coding key.
Accessible from the measurement dialog and from the TPS1100 application programs.

Illumination and display settings:

- Display illumination, contrast and heating
- Reticule illumination
- Activate the Red Laser beam (option for TCR inst.)
- Activate the guidelight EGL (option)

Accessible anytime.

Electronic level and laser plummet.
Accessible anytime.

Program key for TPS1100 standard or Geobasic programs.
Accessible anytime.

Fixed functions key: contains functions that shall be quickly accessible during measurement or from any location, like ppm settings or reflector selection.
Accessible anytime.

Battery Display

The battery status is displayed beside the title bar.

Battery fully charged.

Battery almost fully charged.

Battery still capable to be used.

Battery reserve power: about 25 more distance measurements possible.

There are two different battery symbols:

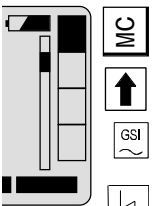
Internal battery is used.

External battery is used.

Graphical status icon

The column to the right of the display is reserved for graphical status icons.

Recording device and communication



PC-Card is inserted. Data is recorded.

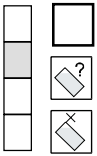
No PC-Card inserted. Data can not be recorded.

RS 232 is selected as recording device. GSI-communication is possible.

Remote Control (RCS) is active. RS 232 is selected for RCS communication.

RS 232 is selected for GeoCOM communication.

Compensator



Compensator functions normally and Hz directions are corrected.

Instrument is tilted, or unstable, or has been turned too quickly.

Compensator and/or Hz corrections are disabled.

Infrared distance measurement active. This icon shows up only on instruments with the option "reflectorless EDM".

Infrared distance measurement active and laserpointer switched on. This icon shows up only on instruments with the option "reflectorless EDM".

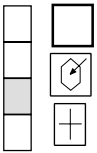
Reflectorless distance measurement active (visible red laser).

Reflectorless distance measurement active (visible red laser) and laserpointer switched on.

Longe range distance measurement active (visible red laser).

Longe range distance measurement active (visible red laser) and laserpointer switched on.

Automatic Target Recognition



ATR and LOCK inactive.

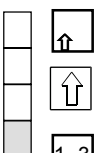
Automatic target recognition (ATR) active.

Automatic target tracking (LOCK) active. But no prism has been aimed at or lock to prism has been lost.

LOCK is active, prism is tracked.

LOCK to prism has been lost. Search in progress.

Key Mode Field



Functions available in the second level of functions keys.

SHIFT has been pressed.

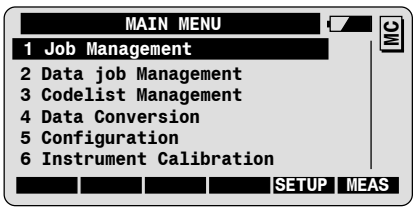
Further digits need to be keyed in.
Displayed when a menu has more than 10 entries.

Quick Code is active. The numeric keys are reserved for Quick Coding.

Select a function from a menu

You can select a function from a menu using the standard or the quick method.

The example below shows how to select the function **“Configuration”** from the main menu dialog.



Standard method

To scroll the cursor bar until the function **“Configuration”** is highlighted.

To confirm the selection and start the function.

Quick method

Press the corresponding numeric key

to select and start the function **“Configuration”**.

For long menus with 10 items or more, both digits displayed in front of the function must be entered.

User Input

User input field are shown in inverse mode on the display.
TPS1100 has three types of input fields:

- Numeric input fields: only numeric values are allowed (e.g. for the reflector height).
- Alphanumeric input fields: both numeric and alphanumeric values are allowed (e.g. for point Id).
- Input from a choicelist: only values included in a predefined list are allowed.

Numeric input

Position the cursor bar on the corresponding input field (e.g. **Refl. Ht.**).

Enter a new value

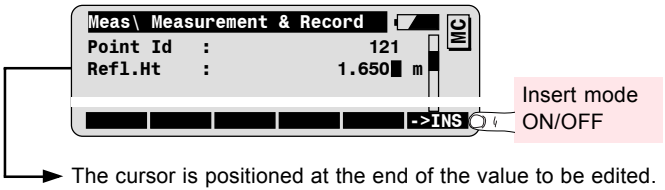
Use the keys [0] to [9] to enter a new numeric value.

The initial value is deleted after the first keystroke.
You can recover it with [ESC].

To confirm the entry.

Edit highlighted value

To start the edit mode for the highlighted value.


Meas\ Measurement & Record
Point Id : 121
Refl.Ht : 1.650 m
MC
->INS
Insert mode ON/OFF
The cursor is positioned at the end of the value to be edited.

To position the cursor on the digit to be edited. The digit can be overwritten now.

To confirm the entry.

Alpha-numerical Input

In alphanumeric mode, one key is used for the input of 3 letters and one number.

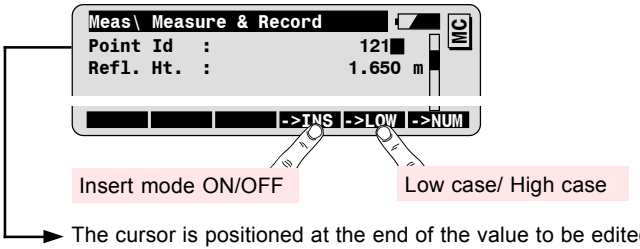
For instance, the key 1 is used to input the letters S, T, U or the number 1.

Press 1 once to input the letter S.

Press 1 twice in quick succession to input letter T, three times to enter letter U and four times to enter number 1.

Enter alpha-numerical value

To start the alpha-numerical input for the highlighted value.



Use the key 0 to 9 to enter alphanumeric characters.

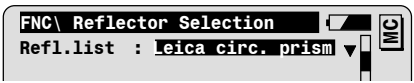
To position the cursor on the digit to be edited. The digit can be overwritten now.

You can change between numeric and alphanumeric input with the key F6 .

To confirm the entry.

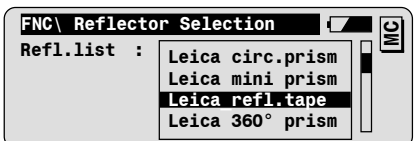
Input from a choicelist

Input fields marked with a triangle (▼) have a predefined list of values (e.g. **Refl.list** in dialog below).

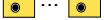


Standard selection method

To open the choicelist



To set the cursor bar on the corresponding value.

Or: 

To start the aphanumeric search for the desired value.

The search feature is available only for longer lists.

To select the highlighted value and close the choicelist.

Quick selection method

To toggle through the choicelist and select the corresponding value.

PC-Card

PC-Cards are used as external memory device on TPS1100 instruments.

Both “SRAM” and “ATA Flash” PC-Cards are supported.

Files and directories

The PC-card can contain any kind of files, whereas the following files are used or created on the TPS1100 instruments:

Type of file	Extension	Fixed Directory
Meas. Job: file for recording measurement data	GSI	PC-Card:\GSI
Data job: file containing control data	GSI	PC-Card:\GSI
Codelist: codelist file	REF	PC-Card:\CODE
ASCII files: files with control data in ASCII format	ASC	free

The filenames are all user defined. The file extension and the file location on the PC-Card are fixed, depending on the type of file.

Data Format

The measurement data can be recorded in GSI-8 or GSI-16 format on the PC-Card.

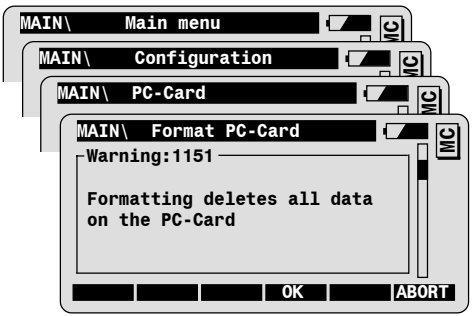
The control data must be available in GSI-8 or GSI-16 format on the PC-Card.

Control data in ASCII format can be converted to GSI format on the instrument using the data converter.

Formatting a PC-Card

The PC-Card can be formatted on the instrument.

5
3
2



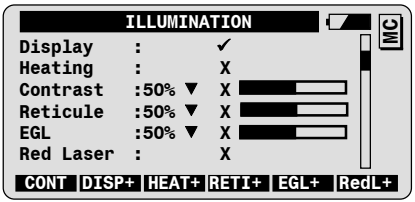
OK
F4

To format PC-Card.

When the PC-Card is formatted, all data are irretrievably deleted!

Illumination, EGL

The illumination dialog can be called anytime.



Lights, heating: ON/OFF

Use the function keys to switch the lights or the heating ON/OFF.

HEAT+ (F2) To turn the display heating on.

DISP+ (F3) To turn the display illumination on.

RETI+ (F4) To turn the reticule illumination on.

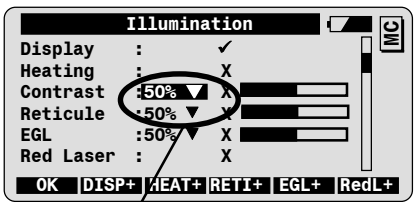
EGL+ (F5) To turn the EGL electronic guide light on (only for TPS1100 instruments with EGL option).

RedL+ (F6) To turn the red laser beam on (only for TPS1100 instruments with Refelctorless EDM).

Intensity settings

You can define the intensity for the following parameters:

- Display contrast
- Reticule illumination
- EGL guide light



To modify the intensity, position the cursor bar on the corresponding field with the PgUp / PgDn -arrow keys, and select the desired intensity with the / ON -arrow keys.

OK F1 To confirm the settings and return to the previous dialog.

Setup

The Setup procedure is used to define the job settings and to setup and orient the instrument on a known station.

To setup the instrument on an unknown station, you can use the TPS1100 programs Resection or Free Station, explained in the Applications Program Field Manual.

The job settings can be defined independantly of the setup procedure, with the function “Job settings” from the FNC-fixed function key (see chapter FNC-fixed function key).

Start the setup procedure from the main menu.

SETUP
F5

To define a new MeasJob.

Job Settings

Meas. Job	Selection of the job for recording measurements.
Data Job	Selection of the job containing the fix point coordinates.
Disp.Mask	Selection of the display mask for the measurement dialog.
REC-Mask	Selection of the GSI recording mask.

Exit after job settings

MEAS F6

To confirm the job settings and continue to the measurement dialog.

Station setup functions

The setup procedure offers two different functions for station setup and orientation:

1. STN F1 — For station setup and orientation by known azimuth.
2. QSET F4 — For station setup and orientation to a known backsight point.

In both functions the orientation is performed to one point.

You can use the TPS1100 program Orientation and Height Transfer to set the orientation from measurements to 1 to 10 tie points.

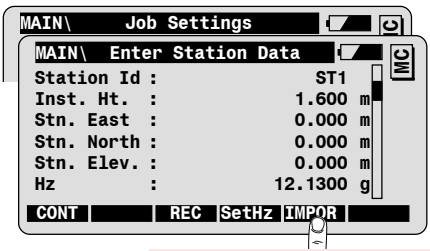
❶ *Station setup and orientation by given azimuth*

This function is used for station setup and instrument orientation, given the station coordinates and the azimut to a backsight point.

Station data

Call the Station function from the Job Settings dialog.

STN
F1

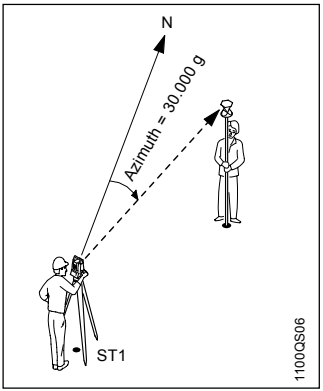


To import station coordinates from data job

Enter the Station Id and the instrument height.

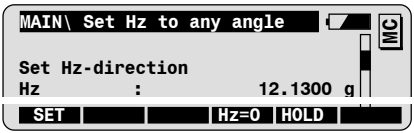
You can enter the station coordinates manually or import them from the data job.

Orientation



Call the dialog for setting the instrument orientation.

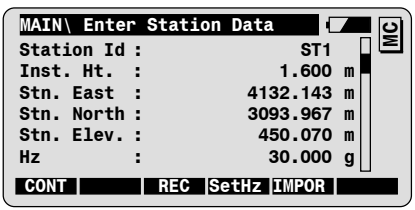
SetHz ● *F4*



Aim to the backsight point.

Enter the azimuth value (e.g. 30.0000g).

SET ● *F1* To set the orientation and return to the station data dialog.



REC ● *F3* To record the station data in the measurement job (optional).

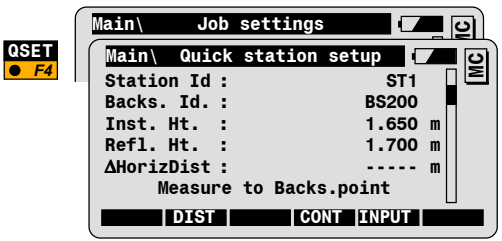
CONT ● *F1* To set the station and continue to the measurement dialog.

❷ *Quick Set with orientation to one backsight point*

This function is used for station setup and instrument orientation, given the station coordinates and the coordinates of one backsight point.

You can enter the station/ backsight coordinates manually or import them from the data job.

Call the Quick Set function from the Job settings dialog.



Enter the Station Id. If available, the coordinates are automatically retrieved from the data job.

Enter the Backsight Id.

Press SHIFT VIEW F5 to view the coordinates of the highlighted value (Station or Backsight Id).

Press **INPUT** *F5* to manually enter the coordinates for the highlighted value.

DIST *F2* To measure a distance to the backsight and check the difference **ΔHorizDist** between measured and computed distance.

SHIFT **REC** *F3* To record the measurements to the backsight point.
(Instrument not yet orientated !)

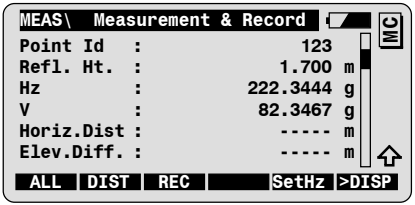
Or **CONT** *F4* To proceed to the next dialog without recording the measurements.

REC *F3* To record station data and backsight point Id. Sets station and orientation and continues to the Measurement dialog.

Or **CONT** *F4* To set station and orientation and continue to the Measurement dialog.

Measure and record

The dialog “Measurement & Record” can be called directly from the main menu or is displayed after the setup procedure.



Angles and distances can be measured and recorded with the following measurement functions.

ALL key

ALL / F1

One keystroke for measuring angles and distance, and for recording measurement data according to the selected REC-mask.

REC key

REC / F3

To record displayed angles according to the selected REC-mask.

DIST and REC combination

DIST / F2

To measure a distance and to display the measured distance.

REC / F3

To record displayed distance and angles according to the selected REC-mask.

Utility functions

List of the functions available in the dialog “Measure & Record”.

SETHZ F5

To set a new value for the horizontal angle circle reading.

>DISP F6

To modify the display content according to the predefined display masks:

- Standard 1: Angles and distances
- Standard 2: Offset and Coordinates
- Standard 3: Point Code and Attributes

SHIFT D INP F2

To manually enter a distance.

SHIFT DEL B F3

To delete the last block registered in the measurement job. The last block can be a measurement or a code block.

SHIFT I<>II F4

Motorized instruments: changing between face I and face II. Manual instruments: displaying the Hz- and V-differences up to the other face. The instrument must be moved manually by the user until the differences are 0.

SHIFT INDIV F5

To enter an individual point Id. After the entry of the individual point Id, the running point Id is displayed again.

FNC Fixed function key

The fixed key FNC provides direct access to additional functions, which might be needed during measurement (see next chapter).

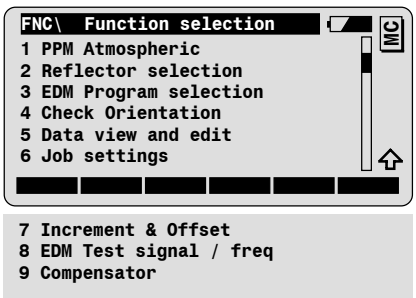
FNC Fixed function key

Introduction

The fixed key FNC provides direct access to a number of functions that are particularly useful during measurement.

Call the FNC function from any dialog.

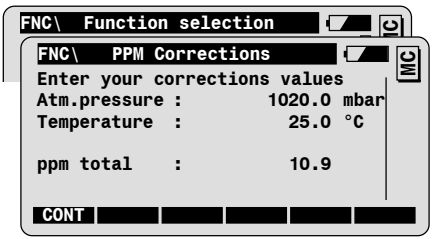
FNC



Start a function by highlighting it with the cursor bar and pressing the -key, or simply by pressing the corresponding numeric key.

PPM Atmospheric

The PPM atmospheric dialog calculates the atmospheric ppm, given the atmospheric pressure and temperature. If needed, the ppm total value can be entered manually.
Call the dialog for PPM atmospheric settings from the Function selection dialog.



Enter the atmospheric pressure and the temperature.
The ppm total value is computed, according to the “Barrel and Sears” equation (see TPS1100 User Manual).

To accept the values and return to the dialog from which FNC has been started.

PPM total manual entry

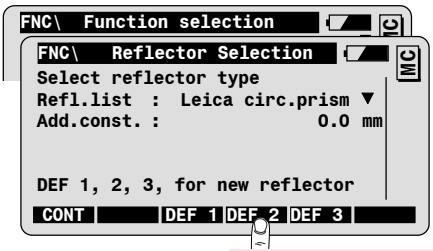
Position the cursor bar on the ppm total value with the cursor key and enter a new value. The values for **Atm. pressure** and **Temperature** are deleted.

Reflector Selection

The Reflector selection dialog allows to select predefined reflectors from a list. The definition of new reflectors with corresponding addition constant is possible.

Call the dialog for Reflector selection settings from the Function selection dialog.

2



To define a new reflector: the reflector name and addition constant can be defined.

Select the reflector from the choicelist.

The addition constant of the reflector is displayd as information.

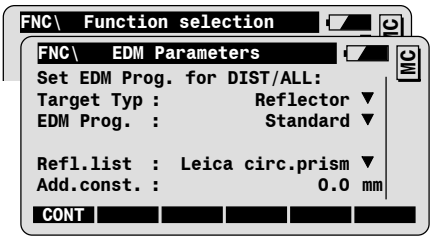
CONT *F1*

To accept the selection and return to the dialog from which FNC has been started.

EDM Program selection

Call the dialog for EDM program selection from the function selection dialog.

3



Select the target type. This function is **only available on** instruments with the option **"reflectorless EDM"**.

Select corresponding EDM program:

- **Standard** or **Fast** distance measurement.
- **Tracking** or **Rapid Tracking**
- **Average**: the parameter "**AVG n max**"allows you to set the maximal number of distances to be averaged (from 2 to 999 distances).

CONT
F1

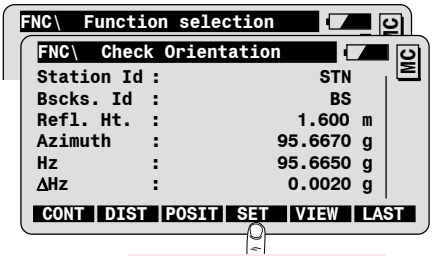
To accept the selection and return the dialog from which FNC has been started.

For more details, refer to the chapter "EDM functions".

Check Orientation

The Check Orientation dialog allows to check the orientation to a known backsight point, and to reset the orientation if necessary.

4



Reset the orientation

Enter the Backsight Id. If available, the coordinates are automatically retrieved from the data job.

Aim to backsight point and compare the angles:

Azimut Calculated Azimut between station and backsight.
Hz Current orientation
ΔHz Difference between calculated azimut and current orientation.

CONT F1

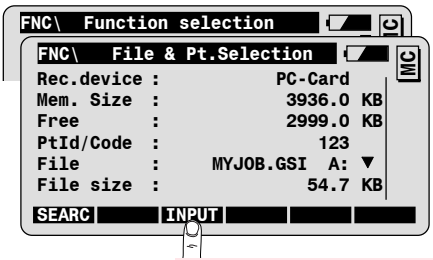
To return to the dialog from which FNC has been started.

Data View and Edit

Data View and Edit allows to search for a point or a code in the measurement job, and/or to manually enter new points.

Call the dialog for data view and edit from the Function selection dialog.

5



Enter new point coordinates

Enter the point Id or the Code to be searched for in the measurement job.

SEARC F1

To start the search and display the data found.

CONT F1

To return to the dialog from which FNC has been started.

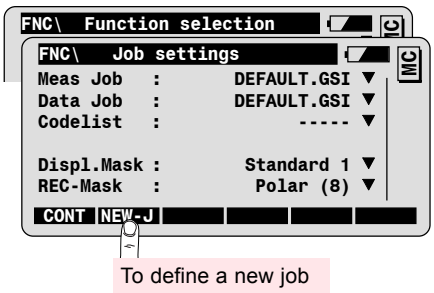
For more details, refer to the chapter “Main Menu Functions”.

Job settings

Job settings allows to modify the current jobs and codelist, and the display and recording mask.

Call the Job settings dialog from the Function selection dialog.

6



Select corresponding measurement job, data job, codelist, display mask and recording mask.

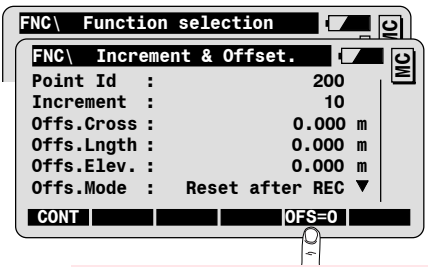
CONT *F1*

To accept values and return to the dialog from which FNC has been started.

Increment & Offset

This dialog allows to define the increment of the point Id. The Cross, length and/ or elevation offsets can be defined for any target point, too.

Call the Increment & Offset dialog from the Function selection dialog.



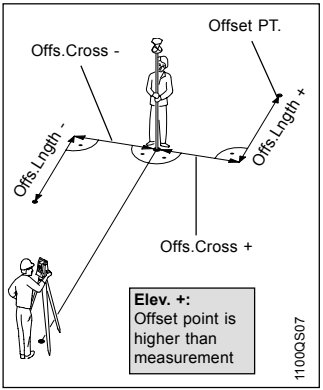
Reset offset values to zero

Increment

Enter the point Id increment and the starting point ID in order to increase the running point no. after every record.

For instance: Increment = 10; starting point Id = 200; point Id's are 210, 220, 230, 240, etc.

Enter Offset values



Enter offset values for the displayed point Id, according to the sign convention explained in the illustration.

Define corresponding Offset mode:

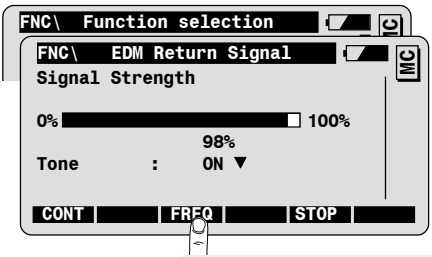
Reset after REC	The entered offset values are reset to zero after the point has been recorded.
Permanent	The entered offset values are applied to all measurements.

CONT ● *F1* To accept increment and/or offset values and return to the dialog from which FNC has been started.

EDM Testsignal / freq

Call the function for testing the EDM signal strength and frequency from the Function selection dialog.

8



To display the EDM frequency

The strength of the signal returned by the reflector is displayed in procent on the instrument.

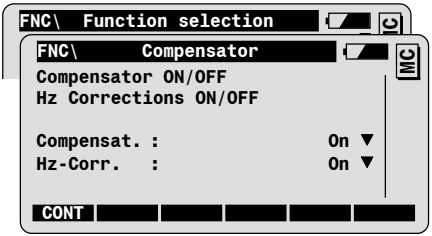
CONT
F1

To return to the dialog from which FNC has been started.

Compensator

Call the Compensator dialog from the function selection dialog.

9



Select the compensator and Hz corrections settings:

Compensat. = ON	V-angles are corrected and relate to the plumb line.
Compensat. = OFF	V-angles are not corrected and relate to the standing axes.
Hz-corr. = ON	Hz-angles are corrected for Hz/V collimation. Standing-axis tilt is corrected only if Compensat.=ON.
Hz-corr. = OFF	Hz-angles are not corrected.

CONT F1

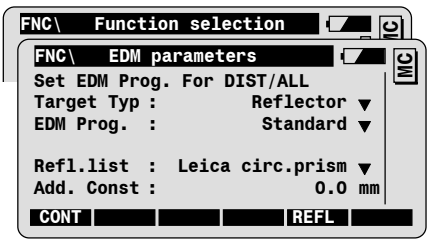
To return to the dialog from which FNC has been started.

EDM Measuring - Program dialog

The selection of the EDM Measuring-program is possible anytime. To set the EDM program to be used when triggering a distance with the functions DIST or ALL, call the FNC-fixed key.

FNC

3



You can also call this function from the Distance Measure dialog after having triggered a distance measurement.

Parameter description

Target Type	Selection of the target type; only on instruments with the option "reflectorless EDM".
= Reflectorless	For reflectorless distance measurement. ☛ The Target type must be set to "Reflectorless" for distance measurements to targets without prism or reflective tape.
= Reflector	For distance measurement to the selected reflector ☛ The target type must be set to reflector for normal and long range distance measurement.
EDM Prog	Selection of the EDM measurement program for the functions DIST and ALL.
= Standard	Standard single distance measurement.
= Fast	Fast single distance measurement.
= Tracking	Continuous distance measurement. The measured distances can be recorded anytime with the REC function key.

EDM Prog (continued)	
= Rapid Tracking	Continuous fast distance measurement. The measured distances can be recorded anytime with the REC function key.
= Average	Average mode.
= Standard Long	For long range distance up to 5000 meters or more. Instruments with the option "reflectorless EDM" only.
= Average Long	Average mode for long range distance measurements. Instruments with the option "reflectorless EDM" only.
AVG n max.	This parameter is displayed only if an averaging EDM program has been selected. Input field for the maximum number of distances to be averaged (from 2 to 999 distances).
Refl.Name	This parameter is displayed only if the target type is set to "Reflector". Selection of the reflector from the list.

Shortcut for switching between EDM-programs

Following functions allow to change the EDM-program for a single distance measurement quickly with two keystrokes.

For instance, if you are measuring distances with the standard EDM-program, and you want to measure a single reflectorless distance.

Switch between reflector and reflectorless

To switch from measurement to a reflector to reflectorless distance measurement (TCR and TCRA only).

To switch from reflectorless to distance measurement to a reflector (TCR and TCRA only).

Switch from single to tracking

To start distance tracking.

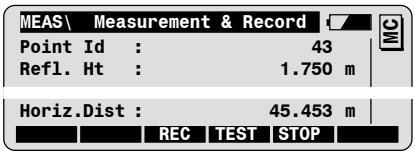
To start standard distance measurement.

To start rapid distance tracking.

To start rapid distance measurement.

Measure and record in tracking mode

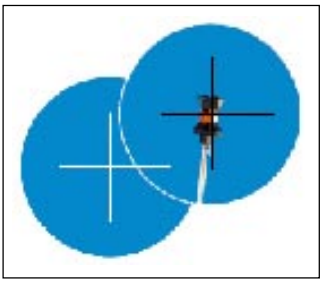
When the instrument is tracking distances, you can edit point Id, Reflector Height, enter codes and record measurement data as usual.



REC ● *F3* To record displayed measurement data, according to the active REC-mask.

STOP ● *F5* To stop tracking.

Introduction



Automatic Target Recognition (ATR) is a feature of TCA and TCRA instruments.

ATR allows automatic angle and distance measurements to prisms. The prism is approximatively targeted with the optical sight on top of the telescope. No focussing is needed. Initiating a distance measurement with ALL or DIST will automatically position the instrument to the prism centre.

The accuracy of ATR measurements depends on the EDM measurement program set. Highest accuracy is achieved with the EDM measurement program “Standard”. Refer to the TPS1100 User Manual, chapter Technical Data for more details concerning ATR accuracy.

As for all other instrument errors, the ATR collimation error can be checked and determined using the calibration function as described in the TPS1100 User Manual.

ATR operating modes

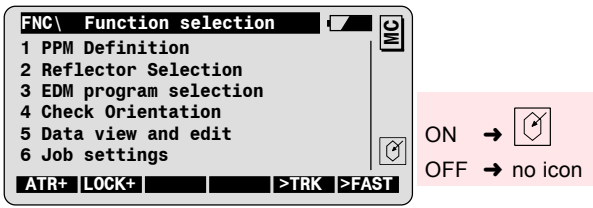
TCA/TCRA instruments can be used in two main operating modes:

- **ATR mode**: automatic measurements to static prisms.
- **LOCK mode**: automatic measurements to moving prism. The instrument follows the moving prism.

ATR mode

Call the FNC fixed key from any dialog to switch the ATR on.

FNC



ATR+ F1

To switch ATR on and return to the previous dialog. The ATR icon is displayed in the status icon column of the display.

ATR- F1

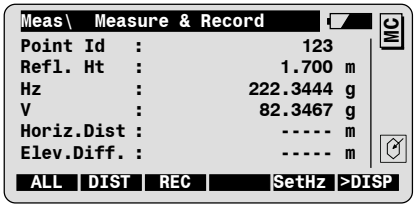
To switch ATR off.

Measure with ATR

ATR is a general function. If switched on, it is active at station setup, during data collection and within all TPS1100 application programs.

To start the Automatic Target Recognition process, you need to trigger a distance measurement with ALL or DIST.

Example: Measure & Record dialog



ALL (F1) To automatically position the telescope to the prism centre, measure angles and distance, and record measurement data.

DIST (F2) To automatically position the telescope to the prism centre, measure and display the distance to the prism.

ATR is also active in the **SetHz** (F5) function, for setting the orientation to a reflector with following procedure:

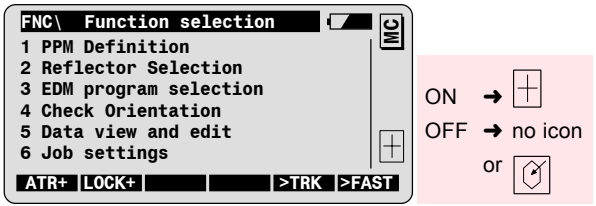
- Approximatively aim at the reflector.
- Enter the azimuth value. ATR will position the telescope to the reflector centre.
- Set the orientation.

If you want to use **SetHz** (F5) to set the orientation to a target without prism, you first need to switch ATR off.

LOCK mode

Call the FNC fixed key from any dialog to switch the LOCK mode on.

FNC



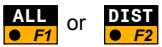
1. Step: Activate LOCK mode

LOCK+ F2

To switch LOCK on and return to the previous dialog.
The icon ⌖ confirms that LOCK is on, but the instrument is not tracking the prism yet.

2. Step: LOCK to stable prism

Approximately aim at the prism. Note that the prism has to be stable and must not move.



To trigger a distance measurement.

Once the icon is displayed, the instrument is locked to the prism. The rod person can move and the instrument will follow the prism.

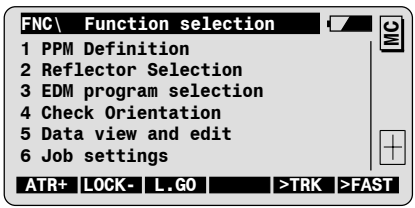
2. Step: LOCK to unstable prism

This functionality is helpful to lock to a prism located on an unstable surface, e.g. on a boat, or near to the instrument.

Aim at the prism and make sure that it is visible within the field of view of the telescope.

FNC

To call the function selection dialog.



L.GO
F3

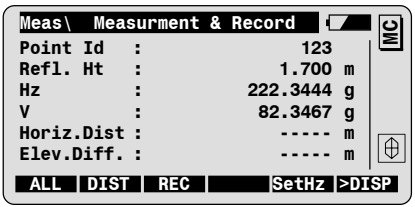
To activate prism tracking and return to the previous dialog.

The icon ⌖ indicates that the instrument is locked to the prism. The rod person can move and the instrument will follow the prism.

Measure with ATR in Lock Mode

Once the TC(R)A is locked to the prism, you can measure and record data with the usual measurement functions. The instrument will follow the prism and position itself to the prism centre everytime you trigger a distance measurement.

If you want to have a realtime display of the distance betweeen the TC(R)A and the moving prism, you can start the distance tracking program, as explained below.

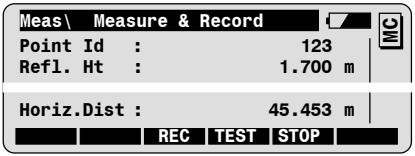


To call the function selection dialog.

Press F5 to switch to the distance tracking mode.

To trigger the distance measurement.

If the EDM Measurement-Program is already set to Tracking or Rapid Tracking, you must only press F2



REC F3 To record displayed measurement data, according to the active REC-mask.

STOP F5 To stop tracking.

Loss of Target Lock

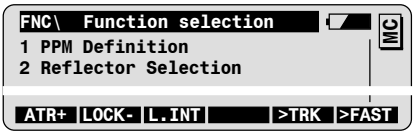
If the instrument looses lock to the prism, the icon is displayed.

A beep signal indicates if the prism has not been found. In this case, you need to manually aim at the prism: the instrument will lock to the prism without additional distance measurement.

LOCK interrupt

To temporarily interrupt lock mode, call the FNC key from any dialog.

FNC



L.INT F3

To interrupt lock and return to the previous dialog.

There are 3 possibilities to re-lock the instrument to the prism:

- Approximatily aim at the prism and measure a distance.
- Approximatily aim at the prism and reactivate lock with the function L.GO F3 from the Function selection dialog.
- Press LAST F5 in the Program selection dialog to position the instrument to the last recorded point.

Note that you can't measure distances to side shot points by interrupting the lock mode. To do so you need to switch the lock mode off.

PowerSearch

Introduction

PowerSearch is an option for the TPS1100plus series that enables the instrument to find a prism at any desired position within a short period of time. When PowerSearch is activated, the instrument starts to rotate around its standing axis. The transmitter emits a vertical laser swath. If the laser swath detects a prism, the rotation of the instrument is stopped. Afterwards a fine aiming in vertical direction is performed by the ATR.

Search modes

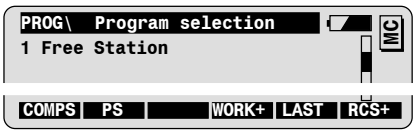
- If no working area has been defined, then the instrument rotates 360° around its standing axis and PowerSearch scans the entire horizon.
- If a working area is defined and activated then PowerSearch only scans within the defined limits.

Starting a search

PowerSearch can always be called up in the menu PROG:

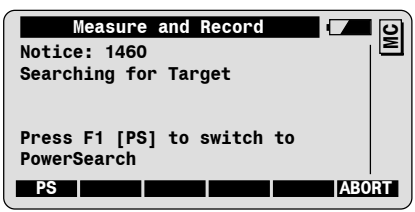
PROG

Calls up the menu selection.



PS
F2

If RCS mode is activated then after triggering ATR search with ALL resp. DIST the following dialogue is displayed:



PS
F1

By pressing PS/F1 the ATR search can be switched to PowerSearch for a quick prism search.

Introduction

TCPS26

RCS1100 Controller

RCS stands for Remote Control Surveying. RCS enables all TPS1100 instruments to be remote controlled. Especially qualified for this purpose are the instrument types with ATR.

The keyboard of the RCS1100 Controller is the same as the TPS1100 keyboard. All functions and programs of TPS1100 instruments are available on the RCS1100.

The communication between the instrument and the RCS1100 is established via radio modems. One radio modem (TCPS26) must be connected to the TCA's serial port. As the RCS1100 has an integrated radio, no additional connections are needed.

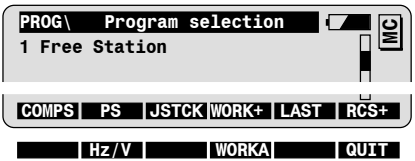
RCS mode must be switched on at the instrument first. After all connections have been made, the RCS1100 can be switched on. This automatically switches on the instrument. After a few seconds, the display of the TCA appears on the RCS1100.

For a complete description of the RCS1100 Controller and the RCS operation functions, please refer to the RCS1100 User Manual.

Measure with RCS

With the RCS1100 controller you can use the instrument measurement functions as if you were using the instrument itself.

Lock the TCA/TCRA to the prism



RCS+ F6

Switch on RCS mode.

Once the RCS mode has been activated, the lock mode on instruments with ATR is switched on automatically, but the instrument is not locked to the prism yet.

If you are at the station, you can manually aim to the prism and trigger a distance measurement with DIST. The icon is displayed as soon as the instrument is locked to the prism.

If you are at the reflector pole, several search modes are available to lock the instrument to the prism. Call the PROG fixed key to access the RCS search modes.

COMPS F1 — To start the compass mode. You need a compass to use this search mode. Refer to the RCS User Manual for more information.

PS F2 — Starts the quick prism search PowerSearch (only available on instruments with optional PowerSearch module)

JSTCK F3 — To position the motorized instruments to the prism with the cursor keys (joystick mode). The left/right cursor keys move the instrument horizontally.

The up/down cursor keys move the instrument vertically. The instrument can be moved faster by pressing a cursor key twice (three different speeds). It can be stopped by pressing any other cursor key.

Confirming with CONT F1 starts to search for the prism and locks if the prism has been found.

SHIFT Hz / V F2 — To position the instrument to the prism by entering angle values. Motorized instruments turn by the corresponding values.

Confirming with CONT F1 starts to search for the prism and locks ifthe prism has been found.

Automatic reflector search

The RCS searching window is rectangular (default: Hz 30gon / V 15gon). If the reflector is found the icon is displayed.

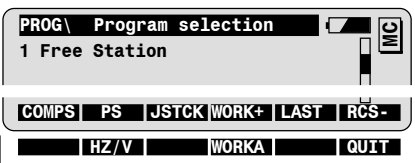
The dimensions of the RCS search window can be defined in the instrument configuration *(see function "RCS Searching Window" in chapter Instrument map)*.

Working Area

In RCS mode it is possible to define a rectangular working area within which the instrument searches for the reflector if the reflector was not found by the default search methods.

Press the PROG fixed key to access the RCS related functions.

PROG

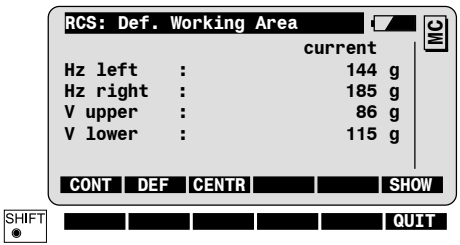


Activate/Deactivate Working Area

WORK+ F4 To activate the defined Working Area.

WORK- F4 To deactivate the defined Working Area.

SHIFT WORKA F4 To display the current settings of the Working Area.



CONT F1 To define a new Working Area by pointing the telescope to the two opposite corners of a rectangular area.

DEF F2 To position the telescope to the upper left / lower right corner of the defined Working Area.

CENTR F3 To centre the working area to the current telescope position (retains the same size of the WA).

SHOW F6 To confirm the displayed values and return to the previous dialog.

Communication settings

If you have communication problems, check the RCS communication parameters set on your instrument (see chapter "Instrument map", "Configuration") and on your RCS1100 controller (see following chapter “Functions behind the FNC key”). They must correspond to those for the TCPS26, which were set in the factory to the following values:

- 19200 baud
- 8 data bits
- No parity

RCS1100 local functions

The RCS1100 local functions allow to set the local parameters of the RCS1100 controller and radio modems.

Functions status

Press down the illumination key for more then two seconds, until the dialog “RCS\ Status Local” is displayed.

> 2 sec.

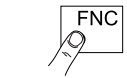
This dialog allows to check or set following parameters:

- RCS controller battery
- Quality of the radio link
- Contrast of the controller display
- Illumination of controller display
- Power off mode of the controller
- Key beep mode
- Heating of the controller display

To confirm the settings and exit the dialog.

Functions configuration

Press down the FNC key for more then two seconds, until the dialog “RCS\ Configuration” is displayed.



This dialog gives access to following functions:

1 To select the language to be displayed on the RCS controller.

2 To select the TPS1100 mode.

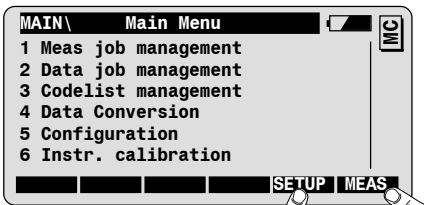
3 To set the serial interface parameters of the RCS controller. They must correspond to the TPCS26 default settings:

- 19200 baud
- 8 data bits
- No parity

4 To configure the link number, which must be changed at the same time on both radio modems. Therefore the TCPS26 must be connected to the RCS Controller.

Main Menu Functions

The Main Menu is the first dialog displayed when the instrument is switched ON.



If desired you can configure your instrument to start up with a dialog of your choice (function "Power On/Power Off" autoexec, see chapter "Instrument map").

General description of the main menu functions

Meas. and Data job management allows to

- Select the measurement and data jobs
- View the job content
- Search for point or code data in the job

- Edit Point Id and codes.
- Input new coordinates.

The maximal number of jobs is 60.

The **Codelist management** function allow to

- Select a codelist from the PC-card and internal memory.
- Create a new codelist.
- Add code and Info's to an existing codelist.

The maximal number of codelist is 32. A codelist can contain up to 500 codes.

Note that the Meas/Data job or codelist selection can also be done in the Job settings dialog, which is part of the Setup procedure.

Data Conversion allows to convert coordinates available in ASCII format on the PC-Card to GSI format, and vice versa.

Configuration gives access to all TPS1100 configuration parameters. Refer to chapter "Instrument map" for a description of the configuration functions.

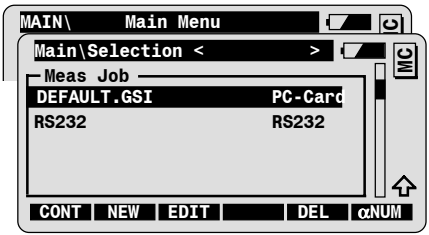
Instrument calibration allows to check and determine the instrument errors (Compensator, V-index, Line of sight, Tilting axis and ATR collimation).
It is explained in detail in the TPS1100 User Manual.

Meas job management

The Meas. job management allows the selection of the measurement job for recording measurement and coding data.

Call the Meas. job management from the Main Menu.

1



Select the measurement job **Default.GSI** for recording data, or any other job available on your PC-Card.

Select RS232 to record data via serial port (RS232) to an external data collector.

CONT *F1* To select the Meas. job.

NEW *F2* To create a new Meas. job.

EDIT *F3* To search for point or code data and to view the job content.

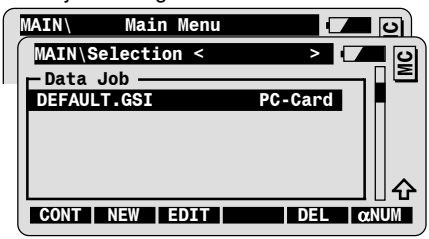
DEL *F5* To delete the selected Meas. job.

Data job management

The Data job is a job containing fixed point coordinates, to be used within stakeout or any other program. The data job must be on the PC-Card in the GSI directory.

Call the Data job management from the Main Menu:

2



Select the Data job.

The Meas. job and the Data job can be the same. In this case, TPS1100 programs will automatically retrieve the first recorded coordinates of the specified point Id.

CONT *F1* To select the Data job.

NEW *F2* To create a new Data job.

EDIT *F3* To search for point or code data and to view the job content.

DEL *F5* To delete the selected Data job.

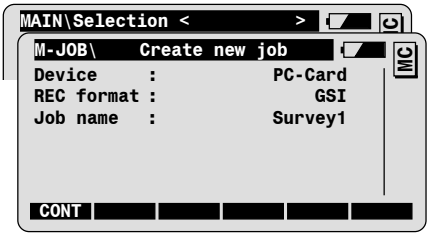
Meas./Data job management functions

The functions explained in this section are available in the Meas. job and Data job management.

Create new job

Call the "New" function from the job selection dialog.

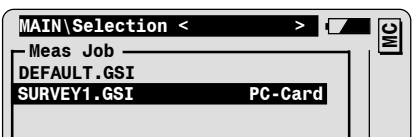
NEW F2



Enter the name of the Meas. or Data job.

CONT F1

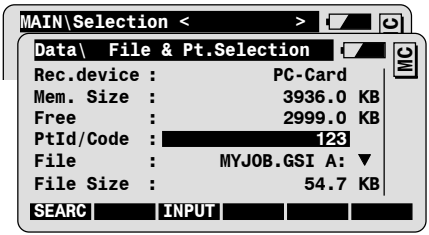
To create new job and continue to the job selection dialog.



Search and view data

Call the Edit function from the job selection dialog.

EDIT *F3*



Enter the point Id or the code to be searched for.

The decimal point can be used as Wild Card

12. search the points beginning with "12"

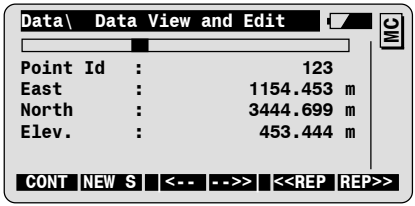
.A. search the points containing "A"

.5 search the points ending with "5"

Select the search file.

SEARC *F1*

To search for point or code data in the selected file.



Values accessible with the cursor bar can be edited, e.g. point Id, Code, Info's.

|<-- F3 | -->| F4 — To display the previous or the next data block in the file.

<<REP F5 | REP>> F6 — To search for the previous or the next data block for specified point Id or code.

CONT F1 — To return to the job Selection dialog.

NEW S F2 — To start a new point Id or code search.

SHIFT |<-- F3 / SHIFT -->| F4 — To display the first or the last point of the file.

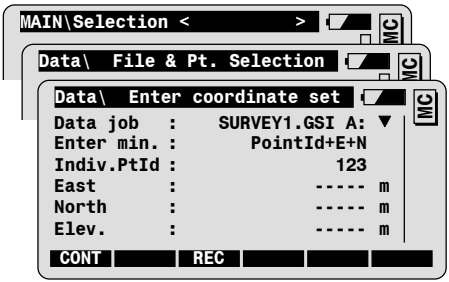
SHIFT DEL F5 — To delete the displayed data block.

Input new point coordinates

Call the "Edit" function from the job selection dialog, then the "Input" function.

EDIT F3

INPUT F3



Enter point coordinates:

Indiv. PtId	Point Id of the new point
East	Easting coordinate
North	Northing coordinate
Elev.	Point Elevation (optional)

REC F3 To record the point coordinates in the selected job.

CONT F1 To return to the File & Pt. Selection dialog.

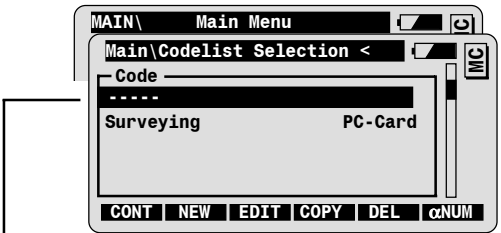
Or SHIFT QUIT F6 To return to the Main Menu.

Codelist management

Call the Codelist Management from the Main Menu.

Note: if no codelist has been found, you will be prompted to define a new codelist.

3



No codelist is selected when the cursor bar is positioned on the dots.

CONT F1 — To select the highlighted codelist.

NEW F2 — To create a new codelist.

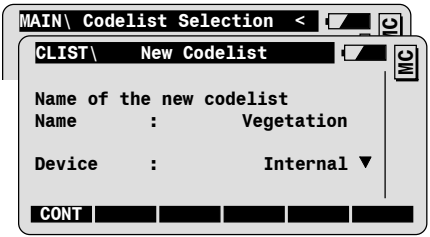
EDIT F3 — To display the list of codes for the selected codelist. Access to the entry of new codes.

COPY F4 — To copy the selected codelist from the internal memory of the instrument to the PC-Card and vice versa.

DEL F5 — To delete the selected codelist.

Create new codelist

NEW
● *F2*

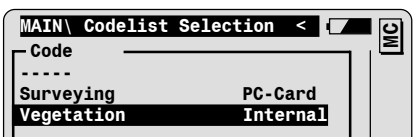


Enter the name of the new codelist.
Enter the device:

Internal	to record the codelist i the internal memory of the TPS1100 instrument
PC-Card	to record the codelist on the PC-Card

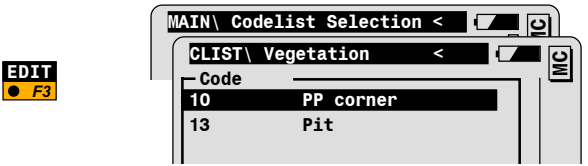
CONT
● *F1*

To create the codelist and continue to the Codelist selection dialog.

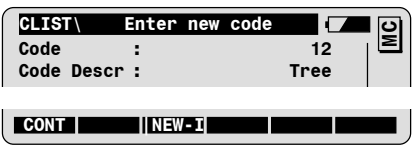


Define new codes

Call the Edit function from the codelist selection dialog to display the list of codes for the selected codelist.



NEW *F2* To add new codes to the list.

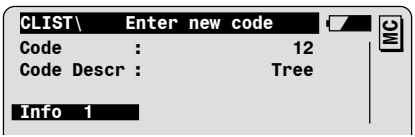


Enter the code data:

Code	Code to be recorded in the measurement job. Alphanumeric values are accepted.
Code Descr	Description of the code: optional. This information will not be recorded in the measurement job.

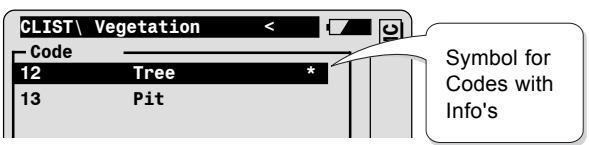
Define Info's for the new code

NEW-I / *F4* To define additional code Infos.
Note: you can define up to eight code Infos.



You can overwrite the default text **Info 1** (e.g. for the code **Tree**, the information **Diameter** might be needed.)

CONT / *F1* To create the new code and display the new content of the codelist.

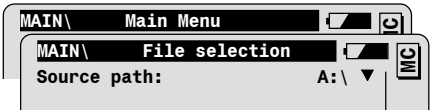


CONT / *F1* To return to Codelist Selection dialog.

Data conversion

Call the "Data conversion" function from the Main menu.

4



Set the file selection parameters:

Source path	Selection of the source file path on the PC-Card
Source file	Selection of the file to be converted from the choicelist.
Format	Display of the source file format.
Output path	Selection of the path for the output file. ☞ Select the path "a:\GSI" for GSI-files to be further used on the instrument.
Output file	Filename of the output file. The filename and its default extension can be modified. Note that the extension must be part of the filename.
Format	Selection of the output format. (GSI-8, GSI-16 or ASCII)

GO
F1

To start the file conversion (the function is available only if the file selection matches with the program configuration).

Data conversion configuration

Call the Data conversion configuration from the Data conversion / File selection dialog.

CONF
F2

Set the source file parameters first:

Search extens.	Entry of the source file extension. - If the source format is GSI, the extension must be **GSI** - If the source format is ASCII, the extension is user definable (e.g. **TXT, ASC**, etc...). Only the files with defined extension will be displayed in the source file choicelist in the File Selection dialog.
Coord. Order	This parameter must correspond to the coordinate sequence in the source file.
Header lines	Number of header lines in the source file. The header lines are ignored during conversion.

Set the output file parameters:

Default extens.	Entry of the output file extension. ☞ If the output format is GSI, the extension must be **GSI** for further use of the converted file on the instrument.
Coord. Order	Selection of the coordinate sequence in the output file.
Separator	Selection of the field separator from the choicelist (parameter available only for ASCII output format)
Decimals	Selection of the number of decimals for the coordinate output.

To accept the settings and return to the File selection dialog.

Standard Coding

The TPS1100 keyboard is equipped with a coding key, CODE

With the coding key, you can enter codes plus up to eight additional informations from the following dialogs:

- from the main measurement dialog.
- from the measurement dialogs of all TPS1100 application programs.
- from the station setup dialogs

The codes and informations are recorded **independently** of the measurement data. You may record the code before or after you have measured and recorded the target point data.

The standard use of the coding key allows the **manual entry** of codes and informations.

You can select a **codelist** to be used with the coding key.

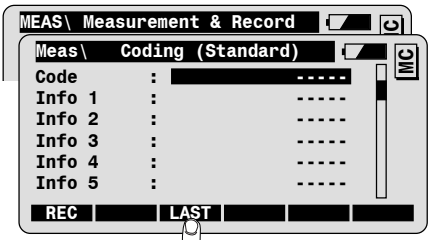
Codelists can be created:

- On the instrument (basic functionality).
- With the PC-software “Codelist Manager”. Please refer to the on-line help of the Leica SurveyOffice Software for more information.

Manual code entry

Press the code key before or after you have measured and recorded the target point data.

CODE



Enter the **code**.
In addition, you may enter up to 8 **Infos** to the code.

REC F1

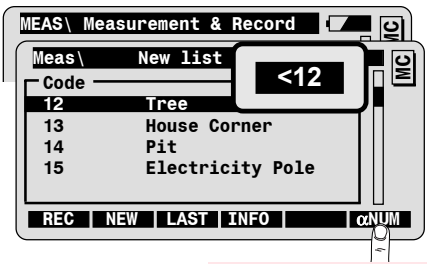
To record code and Infos in the active measurement job.

Code and Infos are recorded in a GSI code block as WI41-WI49.

Standard Coding with a codelist

For coding with a codelist, you must have selected a codelist in a previous step, during the setup procedure or in the codelist management function.

CODE



Code search settings:

αNUM = alpha-numerical search

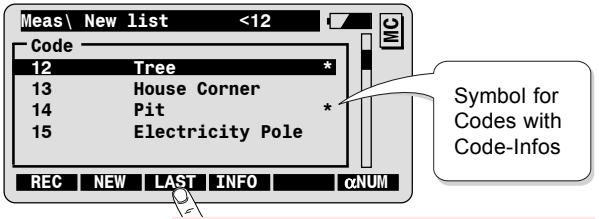
->NUM = numerical code search

Enter the code to be searched for in the title bar (e.g. 12). The cursor bar will be positioned automatically on the corresponding code. You can also step through the list with the UP/DOWN keys after having exited the search mode with the ENTER key.

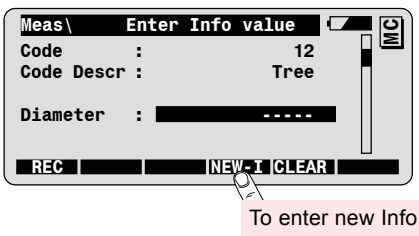
REC *F1*

To record the selected code, and to return to the previous dialog.

Advanced Feature: Enter Info



INFO / **F4** — To enter additional code Infos and/or check default Info values possibly defined in the codelist.



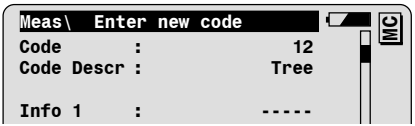
Enter the value for the corresponding code Info.

REC / **F1** — To record the code and the Info values.

Advanced Feature:
Enter new code

NEW F2

To enter a new code to the currently selected codelist.



Enter the code data:

Code	Code to be recorded in the measurement job.
Code Descr	Description of the code: optional This information will not be recorded.
Info 1	Info to be recorded together with the code in the measurement job.

REC F1

To record the code data in the measurement job and add the new code in the codelist.

Advanced Feature: Quick Coding

Quick Coding is a special function for data collection with coding. With one keystroke, you can measure and record target points with code data.

The codes must be available in a codelist, which has been defined with the Codelist Manager from your Leica SurveyOffice Software. The codes must be identified with short cuts to work with Quick Coding. The short cut is a number with one or two digits which is clearly associated to one code.

Typing the short cut number on the numeric keypad will start the **Quick Coding sequence**:

- **ALL :** to simultaneously measure a distance and record a measurement block.
- **CODE :** to select the corresponding code from the codelist and record a code block.

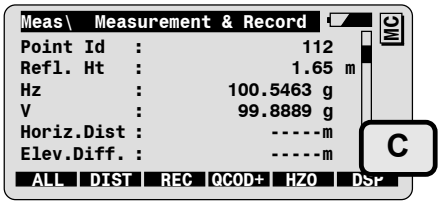
You can configure the quick coding sequence to your needs:

ALL/CODE to record the measurement data first.

CODE/ALL to record the code data first.

Switch ON and measure with Quick Coding

You can switch ON/OFF the Quick Code function in the measurement dialog.



Qcod+ F4 To switch ON Quick Coding. The symbol “C” is displayed as long Quick Coding is switched ON.

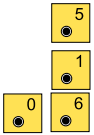
The function Qcod+ F4 is visible only if a codelist with short cuts have been selected.

Enter the short cut number on the numeric keypad to start the combined ALL/CODE sequence.

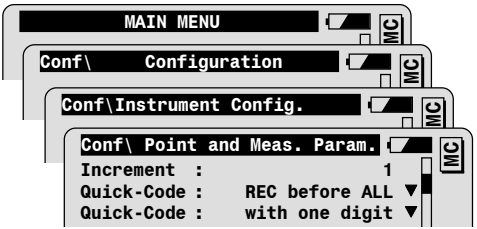
You can use all functions keys available in the measurement dialog while Quick Coding is active.

You can edit values (e.g. Point Id). You need to position first the cursor bar with the up/down arrow keys, then press ↵ to start the edit mode for the highlighted value.

Quick Coding settings



Access the Quick Coding configuration settings from the main menu:



Recording sequence

REC before ALL	Code block recorded before measurement block.
REC after ALL	Code block recorded after measurement block.

Short Cut: number of digits

with one digit	Enter a short cut number with one digit to start the Quick Coding sequence.
with two digit	Enter a short cut number with two digits to start the Quick Coding sequence. ☛ For short cuts with one digit (e.g. 7), you must first enter a zero, then the corresponding digit to start the Quick Coding sequence (e.g. 07).

Point Coding

Point coding allows to record point related codes with up to eight attributes.

The input of point codes is possible in the following dialogs:

- in the main measurement dialog, if point code and attributes have been defined in the display mask.
- in the measurement dialog of some of the TPS1100 application programs. The programs must be configured to use the user display mask and the display mask must contain point code and attributes.

The point codes and attributes are recorded **together with the target point data** (with the function keys REC or ALL).
Note: point code and attributes will be recorded only if defined so in the REC-Mask.

Point codes can be **entered manually** or selected from a **codelist** containing predefined point codes.

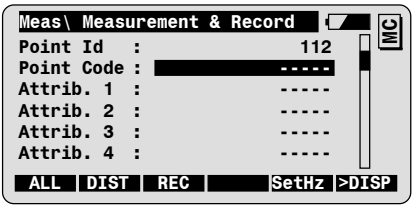
Such a codelist can be created with the PC-software “Codelist Manager”. Please refer to the on-line help of the Leica SurveyOffice Software for more information.

Manual point code entry

Point code entry in the measurement dialog:

To toggle the display mask until **Point Code** and **Attributes** are displayed as shown below:

>DISP
F6



Enter the point code and up to 8 attribute values.

ALL
F1

To simultaneously measure a distance, record the measurement data, the point code and the attribute values.

Or REC
F3

To record the measurement data, the point code and attribute values.

The entered point code and its attributes will be recorded everytime ALL F1 or REC F3 are pressed.

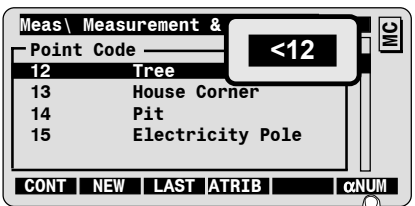
The point code and attributes are recorded together with the measurement data in the GSI measurement block as WI71-WI79 if defined so in the REC-Mask.

Point Coding with a codelist

In order to enable the point code selection from a codelist, you must have selected a codelist in a previous step.

Position the cursor bar on the point code field.

Enter the point code to be searched for (e.g. 12). The correponding point code will be highlighted:



Code search settings:

αNUM = alpha-numerical search

->NUM = numerical code search

CONT (F1) To confirm selection and to return to the measurement dialog.

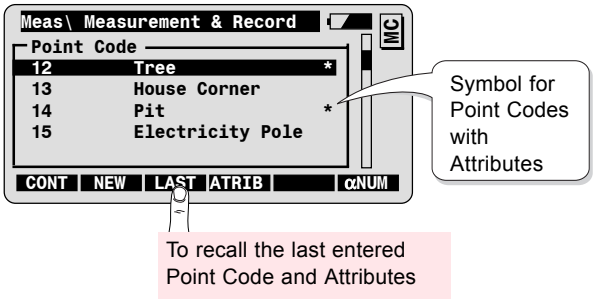
ALL F1 To simultaneously measure a distance, record the measurement data and the selected point code.

Or REC F3 To record the measurement data and the selected point code.

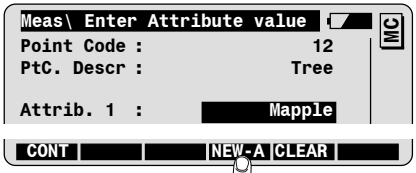
The selected point code will be recorded everytime ALL F1 or REC F3 are pressed.

The point code will be recorded together with the measurement data only if defined so in the REC- Mask. Check your REC-Mask to make sure that the point code belongs to your REC-Mask.

Advanced Feature: Enter attributes



ATRIB F4 To enter additional attribute values to the point code and/or check default values possibly defined in the codelist.



Enter the value for the corresponding attribute.

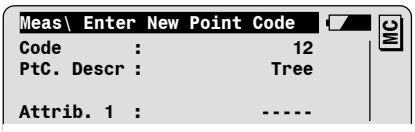
Note that user input is not possible if the attribute can not be recorded in the measurement job. In this case, check and modify the REC-mask definition.

CONT *F1*

To accept the point code and the “Attribute” values and return to the measurement dialog.

Advanced Feature: Enter new point code

NEW F2 To enter a new point code to the currently selected codelist.



Enter the point code data:

Point Code	Point Code to be recorded in the measurement job.
PtC. Descr	Description of the Point Code: optional. This information will not be recorded.
Attrib. 1	Attribute to be recorded together with the Point Code in the measurement job.

CONT F1 To accept the point code data and return to the measurement dialog. The new point code is added to the codelist.

Measurement functions

Coding

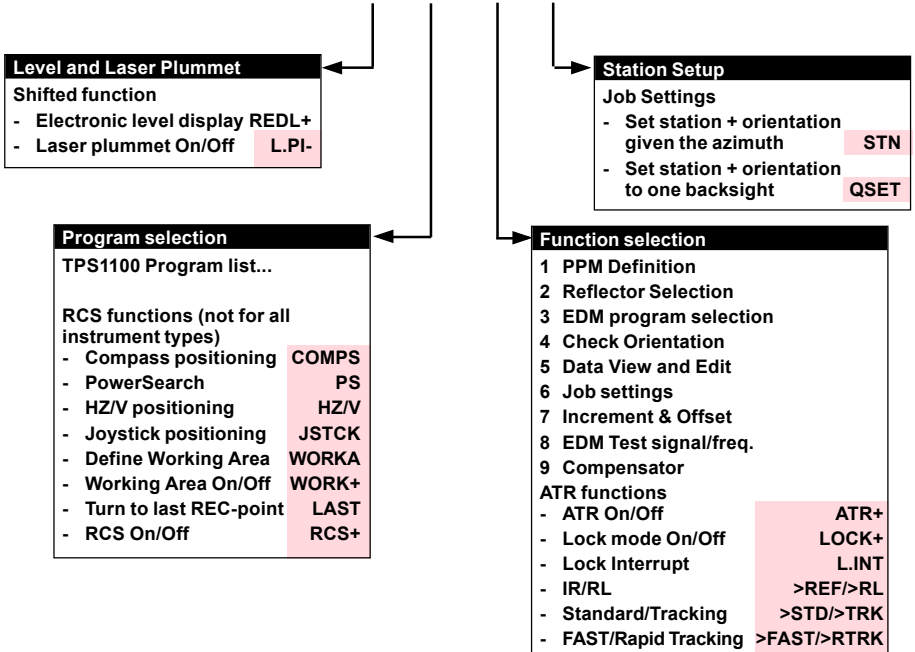
Standard Coding:
Manual entry or codelist selection if codelist selected

Light settings

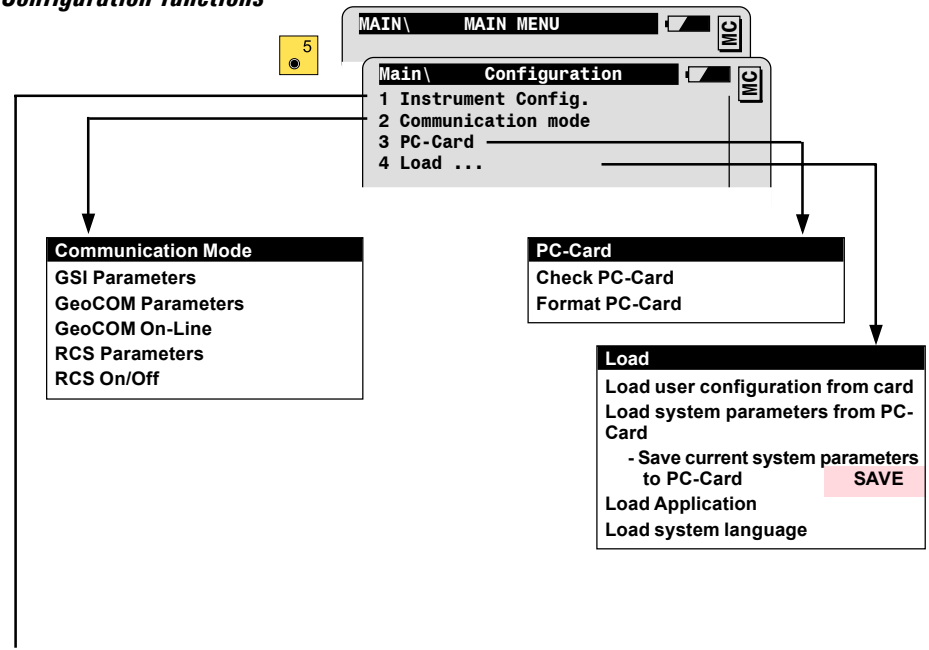
Display light	DISP+
Display heating	HEAT+
Reticule light	RETI+
EGL option	EGL+
Red Laser option	REDL+

Measure & Record

Measure and record functions	ALL, DIST, REC
Quick Coding On/Off	QCOD+
Set Hz reading	SetHz
Toggle display mask	>DISP
Manual distance input	D INP
Face I / Face II	I<>II
Delete last rec. block	DEL B
For individual Pt.Id	INDIV


Level and Laser Plummet
Shifted function
- Electronic level display REDL+
- Laser plummet On/Off L.PI-
Station Setup
Job Settings
- Set station + orientation given the azimuth STN
- Set station + orientation to one backsight QSET
Program selection
TPS1100 Program list...
RCS functions (not for all instrument types)
- Compass positioning COMPS
- PowerSearch PS
- HZ/V positioning HZ/V
- Joystick positioning JSTCK
- Define Working Area WORKA
- Working Area On/Off WORK+
- Turn to last REC-point LAST
- RCS On/Off RCS+
Function selection
1 PPM Definition
2 Reflector Selection
3 EDM program selection
4 Check Orientation
5 Data View and Edit
6 Job settings
7 Increment & Offset
8 EDM Test signal/freq.
9 Compensator
ATR functions
- ATR On/Off ATR+
- Lock mode On/Off LOCK+
- Lock Interrupt L.INT
- IR/RL >REF/>RL
- Standard/Tracking >STD/>TRK
- FAST/Rapid Tracking >FAST/>RTRK

Configuration functions



Instrument Config.

- 01 Units, Decimals, and V-angle display
- 02 Reflector selection
  - Definition of new reflectors DEF1, DEF2, DEF3
- 03 EDM program selection
  - switch reflector to reflectorless
- 04 Power On, Power Off
  Autoexec mode
- 05 Display and Record
  - Define Display Mask DMask
  - Define Recording Mask RMask
  - PPM entry
- 06 Point & Meas. Param
  - Pt.Id mode
  - Increment
  - Offset mode
  - Quick Code settings
  - Info/Attribute entry
  - Auto Dist.

Instrument Config. (continued)

- 07 Date and Time
- 08 RCS Searching Window
- 09 Beep/Hz sector
- 10 Compensator
  - Compensator On/Off
  - Hz corrections On/Off
- 11 Hz System and Face
- 12 Alpha Input mode
  - Delay for character input
- 13 Language

The configuration parameters are explained in detail in the TPS1100 User Manual.

Leica Geosystems AG, Heerbrugg, Switzerland has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

Total Quality Management - Our commitment to total customer satisfaction

Ask your local Leica Geosystems agent for more information about our TQM program.

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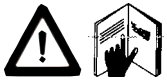
RCS1100 Series

User Manual

Version 1.2
English

Leica Geosystems

Congratulations on your purchase of an RCS1100 system !



This manual contains important safety directions *(refer to section "Safety directions")* as well as instructions for setting up the instrument and operating it. Read carefully through the User Manual before you switch on the instrument.

The instrument model and the serial number of your product are indicated on the type plate underneath.
Enter the model and serial number of your instrument in your user manual, and always refer to **this information** when you need to contact your **agency** or **service workshop**.

Model:_____ Serial no.: _____

Software version:_____

The symbols used in this User Manual have the following meanings:

DANGER :

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION:

Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor injury and/or in appreciable material, financial and environmental damage.

Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

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Operation 17

Care and Storage 30

Safety directions 32

Technical data 41

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RCS1100 stands for Remote Control Surveying. The RCS1100 enables survey instruments of the TPS1100 and TPS1000 series to be remote controlled.

The control unit, the radio modem and the power supply are all contained in a compact, ergonomically-designed housing. The incorporated radio modem is used together with the TCPS26 radio modem as a basic station in the TPS1100.

Instruments in locations which are exposed, difficult to reach, or cramped, can be conveniently operated with the RCS1100 control unit.

Validity of the user manual

This user manual is valid for all RCS1100 units having a built-in radio modem.
Exceptions relating to the RCS1100 without built-in radio modem are indicated. The present manuel describes the software version 1.22.

Unpacking

The RCS1100 is supplied complete with the User Manual and with a software diskette / CD in a padded nylon bag. The outfit also includes an adapter which enables the RCS1100 to be connected to a GLS11 reflector pole. The bag has space for a spare GEB111/121 battery and for a TCPS26 radio modem.

The complete equipment and the accessories for Remote Control Surveying can be reliably transported in the container 667 337 (option), in which all of the components are clearly laid out for rapid installation.

The entire equipment has been designed for rough field conditions but we nevertheless recommend that you use the bags and containers provided when you transport it over long distances. Protect cables, plugs, batteries and antennae against the weather.

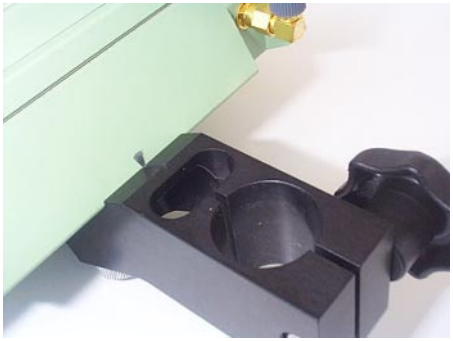
1 RCS1100
2 Holder for reflector pole
3 Battery GEB71
4 360° Reflector
5 Y-cable, Antenna extension
6 Battery GEB70
7 Battery GEB111
8 TCPS26 radio modem
9 Battery GEB121
10 User Manual, installation diskette
11 Antenna

Using the clamping screw provided, secure the reflector-pole adapter at the appropriate height on a GLS11 reflector pole. The adapter can remain on the reflector pole during transport.

Screw the antenna to the end of the antenna extension and connect the antenna extension to the reflector adapter.

Now connect the RCS1100 to the reflector-pole adapter by lining up the marks and tightening the screw. Connect the antenna extension to the RCS1100.
At short distances, or under favourable radio transmission conditions, you can leave out the antenna extension and connect the antenna directly to the RCS1100.

WARNING:
If the radio modem is switched on, do not carry the antenna closer than 15 cm to your body.



Connecting the RCS1100 (lining up the marks on housing and adapter)

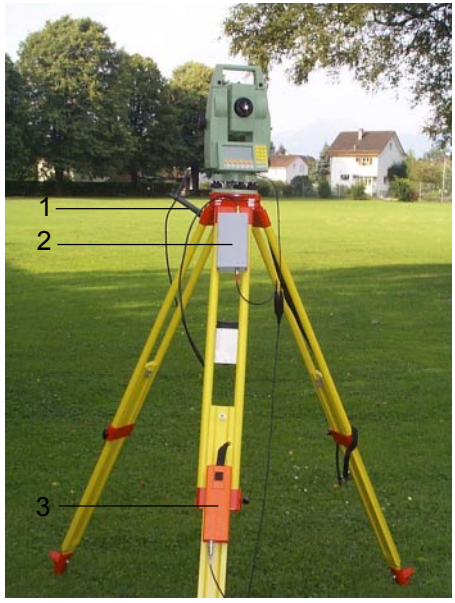
The angle bracket and the position of the antenna socket together ensure that the antenna is vertical.

If the RCS1100 is secured in another manner, make sure that the antenna is vertical, otherwise the transmission range will be restricted.

Reflctor pole, completely set up

Connect the following to the tripod of the instrument: The TCPS26 radio modem, the antenna extension with antenna, and the GEB70 or GEB71 external battery. Make sure that the antenna can transmit freely in the direction of work. The TCPS26 radio modem must be configured as the BASE modem.

Using the Y-cable, connect the survey instrument, the battery and the TCPS26 radio modem. Connect the antenna extension to the TCPS26.

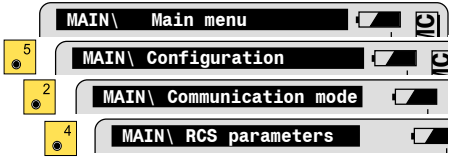


1 Antenna extension
2 TCPS26 radio modem
3 GEB70 external battery

The interface parameters on the TPS1100 / TPS1000 must be inspected and if necessary adjusted to the those for the TCPS26, which were set in the factory to the following values:

19200 baud
8 data bits
No parity

Setting the interface on the TPS1100:

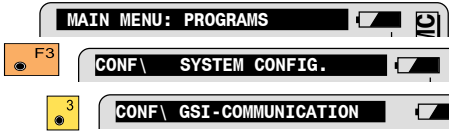


Set the following values

19200 baud
8 data bits
No parity

The remaining values are not relevant.

Setting the interface on the TPS1000:

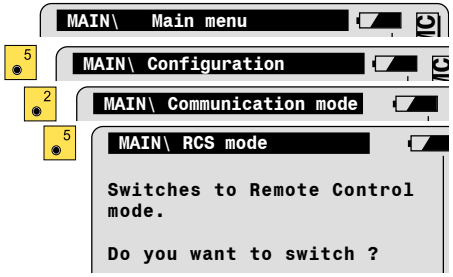


Set the following values:

19200 baud
8 data bits
No parity

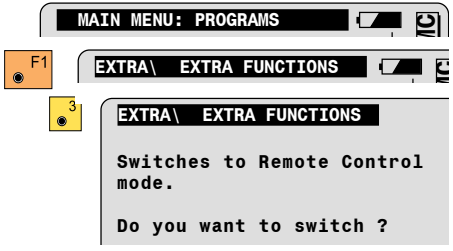
For details, refer to the TPS1000 Systems Handbook.

Setting the interface on the TPS1100:



Confirm with "YES".

Setting the interface on the TPS1000:

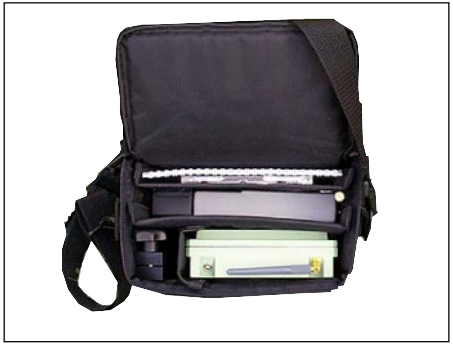


Confirm with "YES".

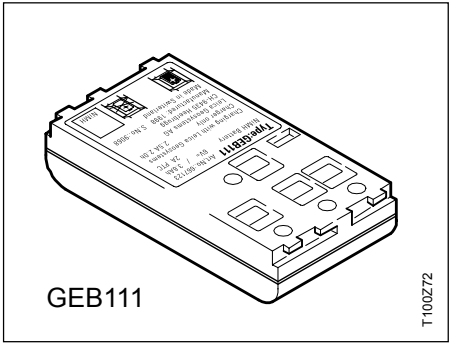
After all connections and settings have been inspected, the RCS1100 can be switched on. This automatically brings the TPS1100 into the RCS mode. After a few seconds, the display of the TPS1100 appears on the RCS1100.

Trouble-shooting

Error	Cause / remedy
No data transfer when starting up (short distance between TCPS26 and RCS1100)	Case 1 - Green LED on TCPS26 does not shine: Inspect battery charge, and cables for TCPS26 Case 2 - Message "No signal" on RCS1100: Inspect battery charge in RCS1100 **or** *possible link numbers* for RCS1100 and TCPS26 are not the same. Case 3 - Green LED shines and message appears on RCS1100: Set interface paarmeters correctly on TPS and TCPS26.
Data transfer possible, but transmission fault	Case 1 - Red LED on TCPS26 flashes: Inspect interface parameters. Case 2 - Red LED on TCPS26 does not flash: Connecting cable is defective
Data transfer is very slow	Disturbance from other transmitters in the 2.4 Ghz frequency band: Change *link number* in RSC1100 and TCPS26.
Interruption during data transfer	Message "No signal" on RCS1100:Operation is at the limit of the range, or there is no visual communication between RCS1100 and TCPS26. Establish visual communication, reduce distance, use antenna extension.



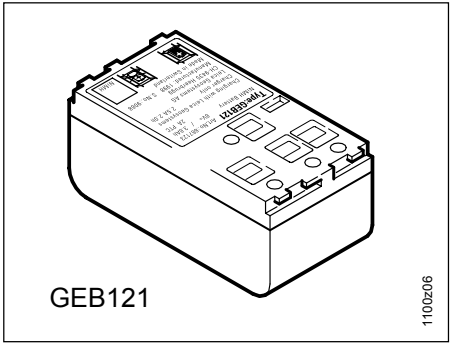
Before packing up the RCS1100 and the TCPS26 in the bag, unscrew the antennae and remove the battery from the RCS1100. For maximum protection during transport, pack the units as shown in the diagram.



Your Leica Geosystems instrument is operated with rechargable plug-in batteries. The GEB111 is the preferred battery for use with the RCS1100, but the GEB121 may also be used.

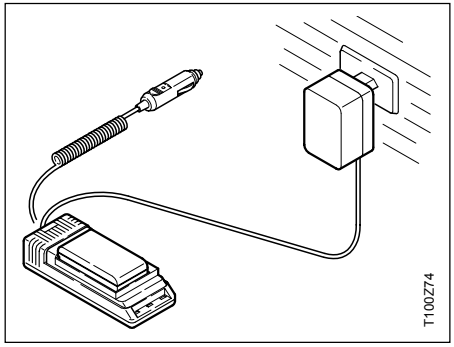
Only use batteries, charging sets and accessories recommended by Leica Geosystems.

In order to fully exhaust battery capacity it is absolutely necessary with new batteries to carry out 3 to 5 complete charging/discharging cycles.



After first charging of batteries you can start immediately with your job. As a result, the batteries will be discharged. Because the operating time of the battery can be very short until full capacity is reached it is recommended to have ready a second battery and the GKL122 battery charger. Using the charger, the battery can be charged/discharged several times before use.

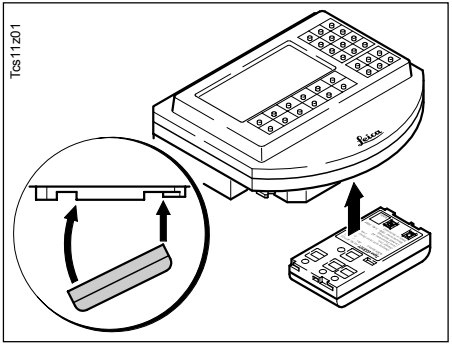
Charging batteries



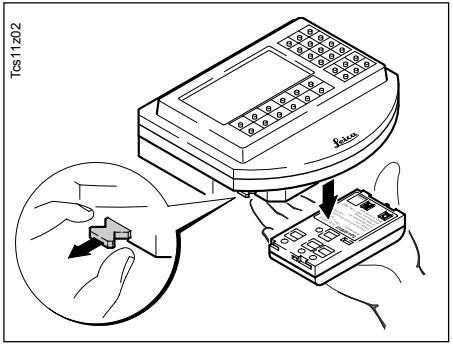
To charge the battery, use the GKL111 or GKL122 charger as described in the instructions provided with that charger.

The chargers are not intended for outdoor use. Adhere to the safety directions.

Inserting and removing batteries



The battery for the RCS1100 fits into a compartment on the underside of the instrument. Push it fully against the side opposite to the catch and then click it into position on the same side as the catch.



To remove the battery, hold it to prevent it from falling and pull out the lever of the catch by about 2mm.

Description of the instrument

The RCS1100 can remotely control almost all of the functions and applications of TPS1100 and TPS1000 series instruments.
The RCS1100 consists of the keyboard and LCD display from the TPS1100, the radio module of the TCPS26, and the power unit.

Because its keyboard and LCD are the same as those in the TPS1100, the RCS1100 is operated in exactly the same way. If the TPS1000 is used, the keyboard template for assigning the keys is applied.

The functions and settings of the RCS1100 are called by keeping the illumination key or function key pressed for at least two seconds:

1. Brightness of LCD display
2. Contrast of LCD display
3. Configuration of beep
4. Heating for LCD display
5. Sleep mode
6. Configuration of internal radio module and of TCPS26
7. Configuration of serial interface
8. Language
9. Operating mode of TPS1100

The status of the battery, and the radio contact, are monitored and can be displayed. If the radio contact is interrupted for a long period, or if the battery charge sinks below a certain level, a warning is displayed.

The RCS1100 has loadable software covering the requirements for controlling the TPS1100/TPS1000 and the local functions. The software also includes all available language elements for the local functions. The software is loaded with the up-load function of the SurveyOffice in the same way as for the TPS1100. The charging procedure is controlled entirely by the SurveyOffice.

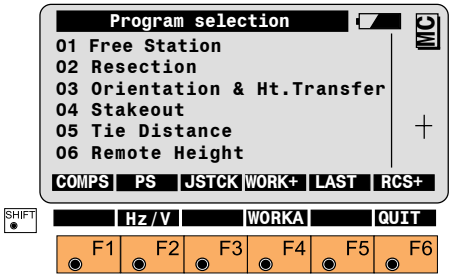
New languages are continually being added for the local functions of the RCS1100. If you cannot find the language which you want, contact your Leica Geosystems agency.

Allocation of keys

The allocation of the keys on the RCS1100 is the same as on the TPS1100.
When the RCS1100 is switched on, the TPS1100 automatically changes to LOCK mode (prism tracking).

The key PROG activates special functions for aligning the TPS1100 with the prism.
The shape of the search window is rectangular (default size: Hz = 30 gon, V = 15 gon). The dimension of the search window in RCS mode can be defined in the "RCS Searching Window" function.

The target functions are required :
- to achieve the first LOCK
- for LOCK replacement in the event of LOCK loss (through longer viewing interruptions).



F1 Sets the TPS1100 to compass mode, enabling the TPS1100 to be targeted on the prism with the help of a compass.

F2 Starts PowerSearch.

F3 In the joystick mode, the TPS1100 can be turned horizontally or vertically with the aid of the cursor keys.

F4 Activate/deactivate working area.

F5 Turns the TPS1100 to the last point stored.

F6 Switches on/off the RCS operating mode.

SHIFT F2 By entering relative or absolute angle values, the TPS1100 can be turned by the corresponding amount or set to the angle value required.

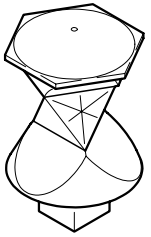
SHIFT F4 Define a working area.

Working in RCS mode is hardly different from working in the normal measuring mode. A switchover is possible on the TPS1100 at any time. The great advantages of the RCS are:

- one-person operation is possible
- when surveying you are at the site of the action, i.e. where the points are being recorded or set out
- you do not have to assess the situation from the instrument location.

It is essential to protect the measurement location. The actions and effects of personnel, machines and the weather can damage the instruments.

After the TPS1100 has been set up and the RCS mode activated, the TPS1100 must be approximately lined up with the reflector in order that a LOCK operation can be carried out on the reflector. TPS1100 instruments equipped with the option PowerSearch are already in LOCK mode after the PowerSearch routine is completed - no lining up is required. After the TPS1100 has locked on the reflector, it follows all movements of the reflector and is set centrically on it. It is therefore advisable to work with the 360° reflector (GRZ4) since this does not require aligning towards the instrument.



360°reflector (GRZ4)

1000Z25

The approximate alignment of the TPS1100 to the reflector can also be performed manually from the instrument.

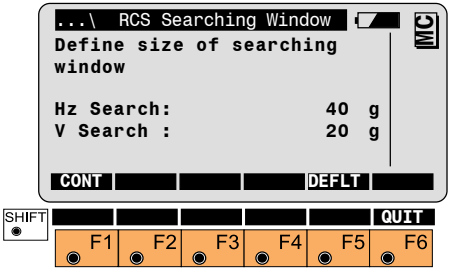
In the measurement display screen the search process can be started at any time. As in normal operation, this happens when you initiate a distance measurement ("**DIST**" or "**ALL**"). The TPS1100 now locks on to the reflector.

Starting from the RCS 1100, an approximate alignment of the TPS1100 to the reflector can take place with the functions available under PROG. The search process can then be started with F1.

These functions will be later described in more detail.

With this function the dimensions of the RCS Searching Window can be defined. If an automatic reflector search is started by pressing ALL or DIST in RCS mode, a search window with the predetermined dimensions is scanned at the current position of the telescope.

5 / 1 / 0 8 Activates the function RCS Searching window.



Hz Search extent of search window in Hz-direction

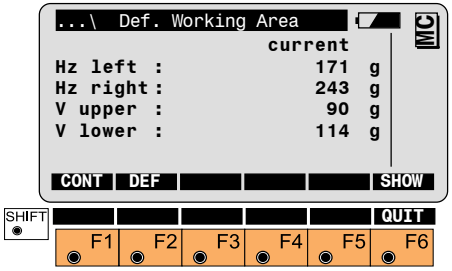
V Search extent of search window in V-direction

F1 To confirm the displayed values and leave the dialog.

F5 Returns all values to default values.

With this function a Working Area can be defined in which the instrument automatically searches for the reflector when working in RCS mode.

PROG SHIFT F4 Activates the function Definition of a Working Area.



Hz left left boundary of working area

Hz right right boundary of working area

V upper upper boundary of working area

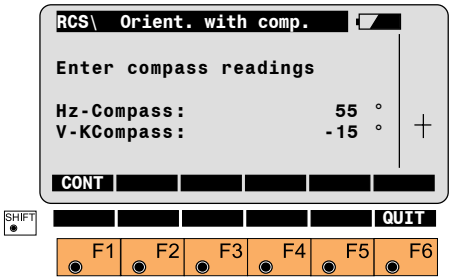
V lower lower boundary of working area

F1 To confirm the displayed values and return to the previous dialog.

F2 To define a new working area by pointing the telescope to two opposite corners of the working area (left corner - opposite right corner).

F6 To position the telescope to the upper left / lower right corner of the defined Working Area.

PROG F1 Activates the compass mode.



In order to use the compass mode we recommend you to use a hand-held compass with 360° rotatable Hz circle and incorporated V circle, e.g. RECTA DP6 or SILVA Ranger 15 / 25.

Compass mode is suitable for aligning the TPS1100 over longer distances.

To establish the link between TPS1100 and compass, proceed as follows:

Step 1:
Perform the Hz orientation on the TPS1100.

Step 2:
Turn the TPS1100 until Hz shows 0.000 (irrespective of the angle units being used).

Step 3:
Look into the telescope of the TPS1100 and select a prominent target.

Step 4:
Aim the compass at the same prominent target and turn the Hz circle of the compass until the compass needle is at 0° or at N (north). Do not turn the Hz circle again.

Aim towards the TPS1100 with the compass from the prism:
- To lock the prism for the first time
- if you lose the LOCK setting.

Read off from the compass:
- the Hz angle indicated by the compass needle (0° to 360°)
- the V angle (+90° to -90°, horizontal = 0°)

and enter these values in the RCS 1100.

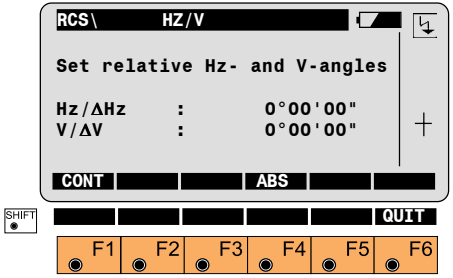
F1 Quits the compass mode and starts the search mode.

PROG F2 Starts the quick prism search using PowerSearch. This function is only available on instruments equipped with the optional PowerSearch sensor.

Two different search modes are available. If no working area has been defined the instrument rotates 360º around its standing axis. In this way, PowerSearch scans the entire horizon.

If a working area has been defined, then PowerSearch is only active within the defined limits.

PROG SHIFT F2 Activates the Hz/V mode.



In Hz/V mode, the TPS1100 can be turned by set angle values.

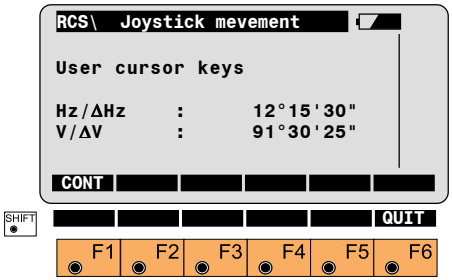
The input options are:

- absolute angle values which relate to the orientation of the TPS1100.
- relative angle values which cause the TPS1100 to turn away from its present position by the amount entered.

F1 Quits the Hz/V mode and starts the search mode.

F4 Switches between absolute (ABS) and relative (REL).

PROG F3 Activates the joystick mode.



In the joystick mode, the cursor keys on the RCS 1100 can be used to turn the TPS1100. The EGL guide light, if available, is switched on automatically.

ON Turns telescope slowly to the right (left).

ON ON Turns telescope rapidly to the right (left).

PgUp Turns telescope slowly upwards (PgDn downwards).

PgUp PgUp Turns telescope rapidly upwards (PgDn PgDn downwards).

To stop the rotary movement, press any cursor key.

F1 Quits joystick mode and starts search mode.

PROG F4 Activates the function activate/deactivate working area.

If the instrument is in RCS mode and the determined working area is activated then the entire working area is scanned for the reflector if the target was not found by the standard search method at the current position of the telescope. If the working area is deactivated only the standard search methods at the current position of the telescope are performed.

The instrument follows the reflector even if the reflector is outside the Working Area.

If the target is lost outside the Working Area a local search will be started. If the reflector was not found the predefined Working Area is scanned.

On instruments with the optional PowerSearch, the working area can be used to limit PowerSearch to a certain area and when activated, PowerSearch only scans within the defined limits.

Last point stored

PROG F5 Activates the LAST function.

If the LOCK mode is lost, this function can be used to turn the TPS1100 back to the last point stored. When the movement is complete, the TPS1100 automatically starts to search for the prism.

Switching the RCS mode

PROG F6 Switches on/off the RCS mode.

For using the remote control the RCS mode must be switched on.

FNC F3 Activates the lock interruption/relock.

This function serves to interrupt the LOCK mode and later to reinstate it, e.g. if the prism is placed on the ground during stakeout or if the TPS1100 is also to be targeted on a second prism.

If this function is called up in the RCS-mode the Joystick dialog is automatically started. The ATR remains active, i.e. if the reflector reappears in the field of view it is immediately relocked.

PROG Hold for min. 2 seconds.

The complete contents of the respective display is transfered if the display is incomplete due to disturbances to the radio link. The function is only available on the RCS.

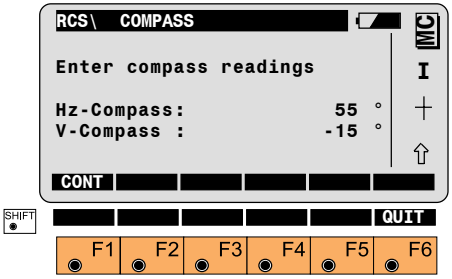
The instrumentation is set up and prepared in the same way as the TPS1100. The keyboard and display differ somewhat from those in the other series and so a keyboard template must be used with the RCS1100. The presentation in the RCS1100 of the dialogues from the TPS1000 differs slightly, but this does not in any way restrict the operation.

The functions specific to the RCS are described in detail in the appropriate section of the user manual for the TPS1000.

The greatest differences are in the display of the icons; this is due to the different dimensions of the display. The time, and the battery status of the TPS1000, are displayed alternately in the title line.

Instead of two lines of three status fields, one line of four status fields is displayed on the right-hand margin.

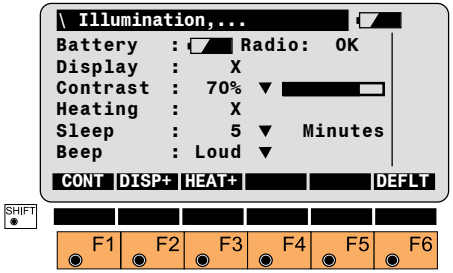
1. The first position normally shows the status for the memory card. The operating mode is not shown, because remote control is only possible in RCS mode.
2. The second position normally shows the telescope face. If the compensator cannot be read out at this time, the current display of the telescope face is superimposed. If the compensator has been switched off, the symbols for the compensator and for the telescope face are displayed alternately.
3. The third position shows the status symbol for the automatic target recognition (LOCK).
4. The last position shows the key mode.



The operating concept for the local functions is the same as in the TPS1100 and is therefore not explained at this point.

Illumination, battery and monitoring of functions

Keep the key pressed down for more than two seconds. The battery status and the quality of the radio link are displayed.

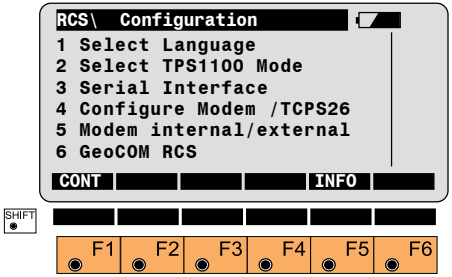


The contrast of the display can be altered. The display illumination and the heating at temperatures below -10°C (high power consumption!) can be switched on and off.

The key beep and the automatic switchoff of the RCS1100 can be altered.

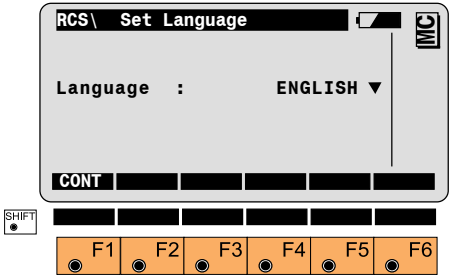
Configurations and settings

Keep the FNC key pressed down for more than two seconds. The available functions are displayed.



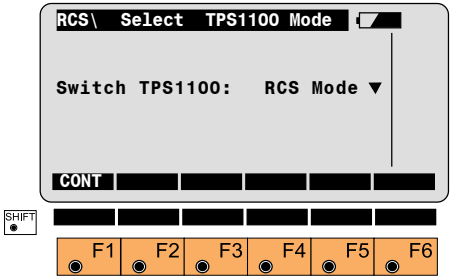
Select Language

Select the required language from the list field.



The choice of language is valid only for the local functions.

Select TPS1100 Mode



Select the mode for the TPS1100

RCS Mode: The TPS1100 can be operated in RCS mode.

GeoCOM: The TPS1100 can be operated in GeoCOM mode (transparent mode).

OFF: Switches off the TPS1100.

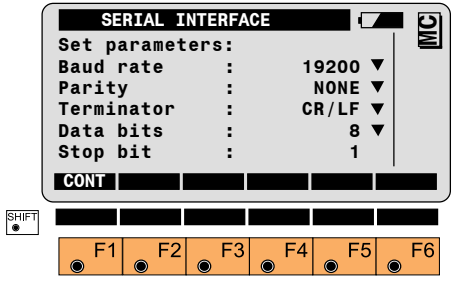
Data may be lost if the TPS1100 is switched off during an application.

Sleep: Switches the TPS1000 to the sleep mode.

Applications which involve the automatic repetition of measurements may be interrupted if the instrument is switched to the sleep mode.

If a TPS1000 instrument is connected, these functions are not available.

Serial Interface



Set the parameters in accordance with requirements.

The standard parameters for the TCPS26 are:

Baud	19200
Data bits	8
Parity	none

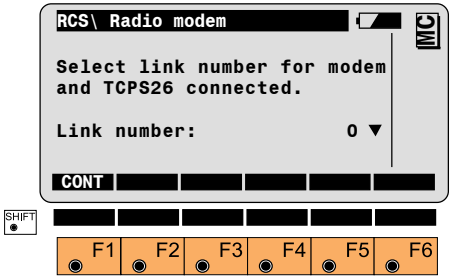
To ensure the correct transfer of data, the settings on the TPS1100 and on the RCS1100 must be the same.

Configure Modem / TCPS26

Disturbances to the radio link can be improved by changing the link number, which must then be altered in the internal radio module and at the same time in the TCPS26.

1. Connect the TCPS26 with a Y-cable to the serial interface of the RCS1100 and to the external battery.
2. Switch on the RCS1100.
3. Press the FNC key for more than two seconds to display the configuration dialogue.
4. Pull out the plug of the TCPS26 and plug it back in to switch on the TCPS26.

5. Call up the function "Radio/ ConfigureTCPS26".
6. Select a link number between 0 and 15.
7. Press the F1 key. The link number is now set correctly in the internal radio module and in the TCPS26.

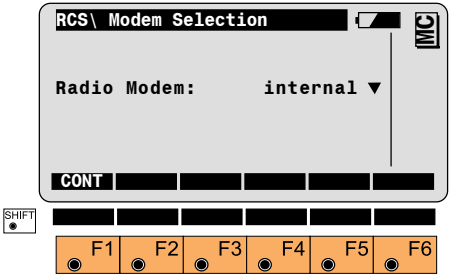


If the baud rate of the RCS1100 differs from that of the TCPS26, keep repeating step 4 above until they agree, when the interface parameters of the RCS1100 will be matched automatically.

If two external TCPS radio modems are used, these must be set in turn to the same link number.

Modem internal / external

It can be ascertained whether the radio modem being used is internal or external.



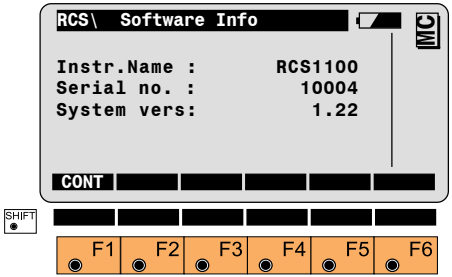
If an external radio modem is used, the interface parameters must be set correctly.
This change will only take effect after switching on/off the RCS1100.

GeoCOM RCS

In order to load a new software version the RCS1100 must be set into the GeoCOM mode. In most cases this happens automatically if the Software Upload of the Leica SurveyOffice is used.

Software Info

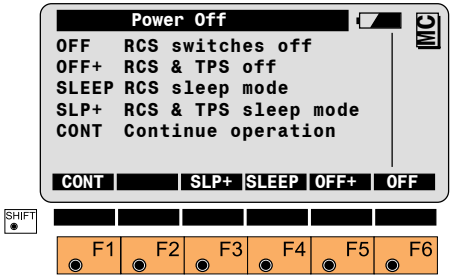
F5 Activates the function Software Info.



Displays instrument name, serial no., and the current system version.

There are different Power Off options available.

Off ON Activates the function Power Off.



F1 Exits Power Off display and returns to the program.

F3 Sleep mode RCS & TPS.

F4 Sleep mode RCS.

F5 RCS & TPS off.

F6 Only RCS switches off.

Transport and Storage

When transporting or shipping the equipment always use the original Leica Geosystems packaging (transport case and shipping cardboard).

Never carry the instrument loose in a **road vehicle**. It can be affected by shock and vibration. Always carry it in its in its transport case or bag and secure it.

When transporting the instrument by by **rail, aircraft** or **ship** use the Leica Geosystems original packaging (transport case or shipping cardboard) or another suitable packaging securing the instrument against shock and vibrations.

Always remove the battery before transporting the instrument. Pack the battery so that no short-circuiting can occur.

When storing the equipment, particularly in summer and inside a vehicle, take the storage **temperature limits** (-40°C to + 70°C / -40°F to +158°F) into account.

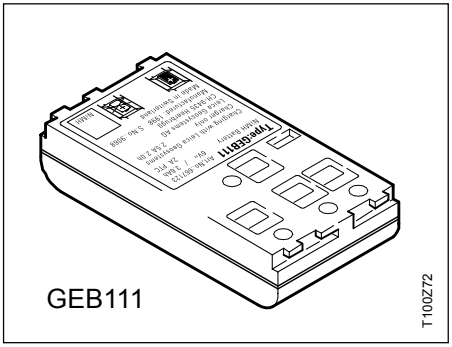
If the instrument becomes wet, leave it unpacked.
Wipe down, clean, and dry the instrument (at not more than 40 °C/ 108°F), transport case, foam inserts, and accessories. Pack up the equipment only when it is perfectly dry.

Cleaning

- Blow away any dust before cleaning.
- Use only a clean, soft and lint-free cloth for cleaning. If necessary, moisten the cloth with pure alcohol.
  Use no other liquids; these may attack polymer components.

Cables and plugs
Keep plugs clean and dry.
Blow out any dirt lodged in the plugs of the connecting cables.
If you unplug connecting cables during the measurement, you may lose data.
Always switch off the instrument before removing the connecting cables.

WARNING:
Use a battery charger in a dry room only, never outdoors. Charge batteries only at an ambient temperature between +10°C and +30°C (50°F to 86°F). We recommend a temperature of 0°C to +20°C (32°F to 68°F) for storing the batteries.



For further information, please refer to *the section "Inserting and removing batteries"*, or to the instructions provided with the battery.

Only use batteries, charging sets and accessories recommended by Leica Geosystems.

In order to reach full capacity with the new batteries it is essential to carry out three to five complete charging/ discharging cycles.

Your Leica Geosystems instrument is operated with rechargable plug-in batteries. The GEB111, an NiMH battery, is the preferred one for use with the RCS1100, but the GEB121 may also be used.

Intended use of instrument

The following directions should enable the person responsible for the RCS1100, and the person who actually uses the instrument, to anticipate and avoid operational hazards.

The person responsible for the instrument must ensure that all users understand these directions and adhere to them.

Permitted uses

The RCS1100 is intended for the following applications:

- Starting of the RCS1100
- Remote control of TPS models
- Recording, editing and managing of measurements
- Data transmission to external appliances (transparent mode)
- Running of applications programs
- Transmitting and receiving measurements

Prohibited uses

- Activation of the RCS1100 without previous instruction
- Use outside of the intended limits
- Disabling safety systems and removal of hazard notices
- Opening the instrument using tools (screwdriver, etc.), unless this is specifically permitted for certain functions
- Modification or conversion of the instrument
- Activation after misappropriation
- Use with accessories from other manufacturers without the prior express approval of Leica Geosystems (only the antennae provided by Leica may be used)
- Inadequate protection at the measurement location (e.g. when carrying out measurements on roads)
- Control of machines, objects in motion or similar with the RCS1100 Remote Control System

WARNING :
Adverse use can lead to injury, malfunction, and damage.
It is the task of the person responsible for the instrument to inform the user about hazards and how to counteract them. The RCS1100 is not to be used until the user has been properly instructed how to use it.

Limits of use

Environment:
Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments. Use in rain is permissible for limited periods.

Refer to section "Technical data".

Responsibilities

Area of responsibility for the manufacturer of the original equipment Leica Geosystems AG, CH-9435 Heerbrugg (hereinafter referred to as Leica Geosystems):

Leica Geosystems is responsible for supplying the product, including the user manual and original accessories, in a completely-safe condition.

Responsibilities of the manufacturers of non-Leica Geosystems accessories:

The manufacturers of non-Leica Geosystems accessories for the RCS1100 are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica product.

Responsibilities of the person in charge of the instrument:

WARNING:

The person responsible for the instrument must ensure that it is used in accordance with the instructions. This person is also accountable for the training and deployment of personnel who use the instrument and for the safety of the equipment when in use.

The person in charge of the instrument has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To be familiar with local regulations relating to accident prevention.
- To inform Leica Geosystems immediately if the equipment becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of radio transmitters are respected.

WARNING:

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the instrument.

WARNING:

The **charger** must not be used in damp or inclement conditions. If moisture penetrates the charger, the user may receive an electric shock.

Precautions:

Use the charger only indoors, in dry rooms. Protect it from damp. If the charger is damp, do not use it.

WARNING:

If you open the **charger**, either of the following actions may cause you to receive an electric shock:

- Touching live components
- Using the charger after incorrect attempts to carry out repairs.

Precautions:

Do not open the charger yourself. Only a Leica Geosystems-approved service technician is entitled to repair it.

DANGER:

Because of the risk of electrocution, it is very dangerous to use reflector poles in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

WARNING:

By surveying during a thunderstorm you are at risk from lightning.

Precautions:

Do not carry out field surveys during thunderstorms.

WARNING:

During target recognition or stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around or between the instrument and the target (e.g.: obstacles, excavations or traffic).

Precautions:

The person responsible for the instrument must make all users fully aware of the potential dangers.

WARNING:
Inadequate securing of the surveying site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.
Precautions:
Always ensure that the survey site is adequately secured. Adhere to the regulations governing accident prevention and road traffic.

CAUTION:
With the remote control on TPS models, it is possible that extraneous targets will be picked out and measured.
Precautions:
When measuring in remote control mode, always check your results for plausibility.

WARNING:
If computers intended for use indoors are used in the field, there is a danger of electric shock.
Precautions:
Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems instruments.

CAUTION:
If the accessories used with the instrument are not properly secured, and the equipment is subjected to mechanical influences (e.g. shocks, falling), the equipment may be damaged or people may sustain injury.
Precautions:
When setting-up the instrument, make sure that the accessories (connecting cables etc.) are correctly adapted, fitted, secured and locked in position. Avoid subjecting the equipment to mechanical shock.

CAUTION:
During the shipping or disposal of charged batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:
Before shipping or disposing of equipment, discharge the battery (by running the instrument until the batteries are exhausted).

WARNING:
If the equipment is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are exposed to a high heat source, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the equipment irresponsibly you may enable unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

Precautions:
Dispose of the equipment appropriately in accordance with the regulations in force in your country. Always prevent access to the equipment by unauthorized personnel.

The term "electromagnetic acceptability" is taken to mean the capability of the RCS1100 to function correctly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances in other equipment or biological damage to humans or animals.

WARNING:
Electromagnetic radiation can cause disturbances in other equipment.

Although the RCS1100 meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

Only for RCS1100 **with** integrated radio modem:

WARNING:
Electromagnetic radiation can cause disturbances in other equipment, in installations (e.g. medical ones such as pacemakers or hearing aids) and in aircraft. It can also affect humans and animals.

Although the RCS1100 meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed or that humans or animals may be affected.

- Do not operate the RCS1100 in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the RCS1100 near to medical equipment.
- Do not operate the RCS1100 in aircraft.
- Do not operate the RCS1100 for long periods with it immediately next to your body.
- Only use original Leica Geosystems accessories.

CAUTION:
There is a risk that disturbances may be caused in other equipment if the RCS1100 is used in conjunction with accessories from other manufacturers (e.g. field computers, personal computers, portable radios, non-standard cables, external batteries).
Precautions:
Use the equipment only with accessories from Leica Geosystems. When combined with the RCS1100, the strict requirements stipulated by the guidelines and standards are assured. When using computers and 2 way radios, pay attention to the information provided by the manufacturer regarding electromagnetic acceptability.

CAUTION:
Disturbances caused by electromagnetic radiation can cause faults in the transmission of data.

Although the RCS1100 meets the strict regulations and standards which are in force in this connection, Leica Geosystems cannot completely exclude the possibility that the RCS1100 may be disturbed by very intense electromagnetic radiation, for instance near radio transmitters, 2 way radios, diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

WARNING:
If the RCS1100 is operated with cables attached at only one of their two ends (e.g. external power supply cables, interface cables, etc.), the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other instruments may be impaired.
Precautions:
While the RCS1100 is in use, cables (e.g. instrument to external battery, instrument to computer) must be connected at both ends.

Only for RCS1100 **without** integrated radio modem:

WARNING:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.
However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

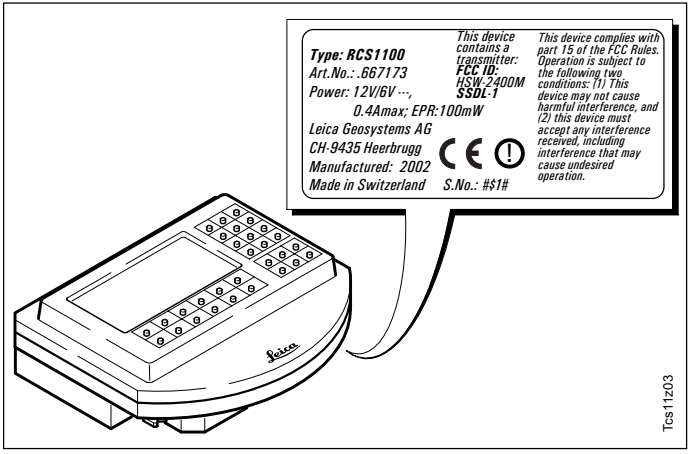
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING:

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Product labelling:

This device complies with part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.


Type: RCS1100
Art.No.: .667173
Power: 12V/6V ⎓,
0.4Amax; EPR:100mW
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured: 2002
Made in Switzerland
S.No.: #$1#
This device contains a transmitter:
FCC ID:
HSW-2400M
SSDL-1
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Tcs11z03

Design
- Aluminium housing with integrated NiMH battery and with optional radio modem.

Battery GEB111
- Type: Nickel metal hydride (NiMH)
- Capacitance: 1.8Ah

Power supply

The voltage when using an external cable must be within the range 11.5V to 14V (DC)

Current consumption
- 12/6V=
- 0.4 Amax

Environment
- Splashproof and dustproof (IP53 in accordance with IEC 529)

Temperature

Operation: -20°C to +50°C (-4°F to +122°F)

Storage: -40°C to +70°C (-40°F to +158°F)

Dimensions
- 160 mm x 135 mm x 50 mm

Weight
- RCS1100 including modem 770g
- Battery GEB111 200g
- Reflector pole adapter 180g

Interface
- Conformable with RS232
- TxD, RxD, GND
- No hardware handshake

Baud rate
- 2400/4800/9600/19200/34800 bps
- Serial, asynchronous

Data format
- 7/8 data bits
- 1/2 stop bits
- Parity none/even/odd

Keyboard and display

Alphanumeric characters	Maximum 256
Character set	Expandet ASCII set as standard. An optional character set can be loaded in addition
Type of display	LCD
Size of display	8 rows of 32 characters
Graphics capability	Yes, 64 x 256 pixels

Plugs
- One five-pole Lemo-0 plug for external battery connection and data transfer

Conformity to national regulations

- FCC part 15 (applicable in U.S.)
- European directive 1999/5/EC on radio equipment and telecommunications terminal equipment (see CE Conformity Declaration).
- The conformity for countries with other national regulations not covered by FCC part 15 or European directives 1999/5/EC has to be approved prior to use and operation.

Frequency range
Limited to 2446.5 - 2483.5 MHz

Transmission power
< 100 mW (e.r.p.)

Antenna
- λ/2 -360° with SMA connector.

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Leica Geosystems AG, Heerbrugg, Switzerland, has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

Total Quality Management-
Our commitment to total customer satisfaction

Ask your local Leica Geosystems agent for more information about our TQM program.

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TPS1100 Professional Series

Application Programs Reference Manual

Version 2.2
English

Leica Geosystems

Congratulations on your purchase of your programs for a TPS1100 Professional Series.

For safe system use, pay attention to the important safety regulations in the "System" instructions *(refer to chapter "Safety directions")*. Read carefully through the User's Manual before you switch on the instrument.

The instrument model and serial number of your product are indicated on the label in the battery compartment.
Enter the model and serial number in your manual and always refer to this **information** when you need to contact your **agency** or authorized **service workshop**.

Type: _____ Serial no.: _____

SW version: _____ Language: _____

The symbols used in this User's Manual have the following meanings:

DANGER:
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING:
Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.

CAUTION:
Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and / or appreciable material, financial and environmental damage.

Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

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The electronic theodolites and total stations in the TPS System 1100 are equipped with programs for processing field data and control-point coordinates. The systems are therefore highly functional and classical survey tasks are simplified appreciably.

All program sequences are based on a unified structure. The clearly-designed display with the function keys makes learning easy. Each program has a configuration dialog. In this dialog, the user can match program-specific parameters to changes in requirements and sequences. The various possibilites are described in the instructions for the individual programs.

Calling up a program

The TPS1100 keyboard is equipped with a program key: PROG

Pressing this key will display a menu with all programs installed on your instrument.

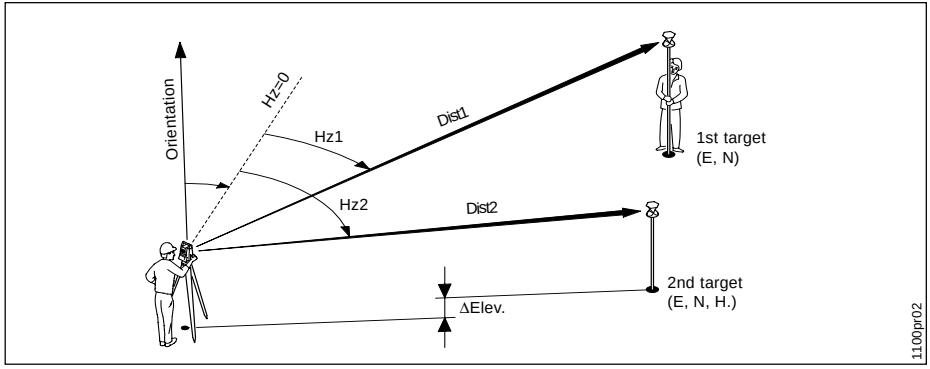
Licence Code

When starting certain programs, it can happen that a licence code is requested. The licence code is needed to run the program with full functionality.
Without licence code, you can run the programs in a demonstration version, but you will not be able to calculate and store the results.

The licence code is available from your Leica Geosystems agency, who will inform you about licence fees for code protected programs.

Introduction

This manual describes the "Orientation and Height Transfer" program of the TPS1100 Professional series.

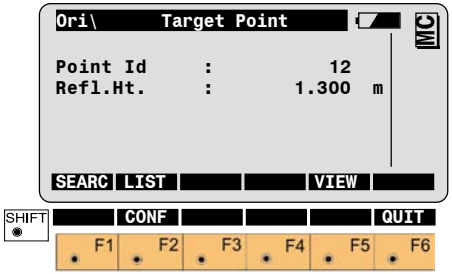


The instrument must be set up on a known point. The program "ORIENTATION" calculates an angular correction for the instruments horizontal circle, so that 0.0000 of the horizontal circle corresponds with grid north (Orientation correction), using reference points with known Easting and Northing.

For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known. You may use target points with elevation only.
The program handles a maximum of 10 points.

Target Point

Enter the target point number and height of the reflector



F1 Retrieve the coordinates of the target point. Search the coordinates of the point entered in the active data job and go to the measure mode.

F2 Define a list of target points and the measurement sequence. For further use: selection of points from the list is possible.

F3 Displays the previous point from the list of points entered. Note that this key will not be available until there is at least one point in the list.

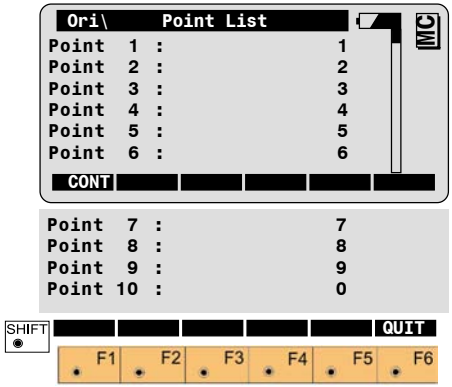
F4 Displays the next point in the list of points entered. Note that this key will not be available until there is at least one point in the list.

F5 Search and display the coordinates of the point found in the active data job.

F6 Run the calculation. Note, the F6 key will be assigned after the first measurement.

SHIFT F2 Start the "CONFIGURATION"

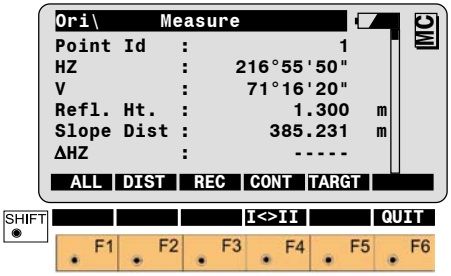
Enter a maximum of 10 points. The same point can be retrieved several times.



F1 Return to the dialog "Target Point".

This dialog is similar to the TPS 1000's basic "Measure Mode" dialog. Once a measurement is taken, the program will return to the dialog "Target Point" to acquire the next point for measuring.

If the orientation correction can be calculated successfully from any of the first measurements, the ΔHz and ΔV values are displayed for further entered target point. Motorized theodolites will automatically drive the telescope to the target point.



F1 Simultaneously measure and record data on the active recording device.
Return to the dialog "Target Point".

F2 Measure a distance.

F3 Record the measurement on the active recording device.
Return to the dialog "Target Point".

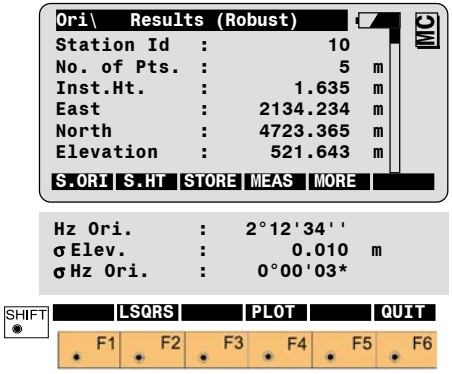
F4 Accept the measurement and return to the dialog "Target Point".

F5 Enter target data.
(see User Manual)

SHIFT F4 Change the theodolite face.

SHIFT F6 Exit the program.

Calculates the orientation, the elevation and the respective standard deviations.



Station Id.
Point number assigned to the station

No. of Pts.
Number of points measured

Inst.Height
Instrument Height

East
Easting of the station

North
Northing of the station

Elevation
Calculated elevation of the station

Orientation
Oriented direction

σ Elevation
Standard deviation of the Elevation

σ Orient
Standard deviation of the Orientation

F1 Set orientation on the instrument.
Note that once this key has been pressed it will not be possible to execute more measurements.

F2 Set station elevation on the instrument.
Note that once this key has been pressed it will not be possible to execute more measurements.

F3 Record the following results into the active measurement job

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

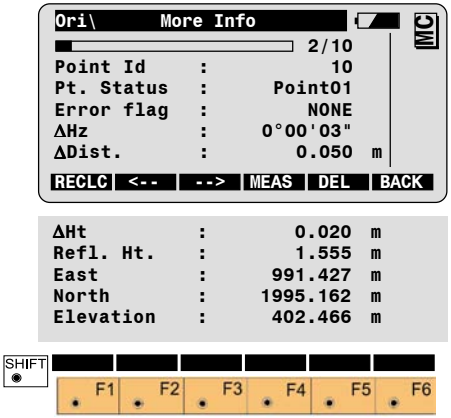
F4 Measure more points. The program will recall the "TARGET POINT" dialog.

F5 Show the results of individual measurements on the screen (*see dialog "More Information"*).

SHIFT F2 Select between the "Robust" method and the "Least Square" method.

SHIFT F4 Sketch of the station and the reference points used.

Display the residuals of individual measurements. You can also disable points from the calculation of orientation or height as well as delete erroneous measured points.



2/10
Sequence number of the current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Status
Use this measurement for calculation (ON/OFF).

Pt. Status
ON Measurements to target point used for calculation.
Ignore Elev.
Target point elevation disabled: measurements for elevation determination not used in calculation.
OFF Target point disabled: measurements to point NOT used for calculation.

Error Flag
Identified erroneous measurements. Possible values are:

NONE	measurement is OK
HZ	horizontal angle error
DIST	distance error
HT	height difference error

The flags may also be combined, i.e. DIST + HZ

Δ Hz.
Difference between calculated and measured horizontal angle

Δ Distance
Difference between calculated and measured distance

Δ Height
Difference between calculated and measured height
Refl. Ht.: Reflector height used for the target point
Easting, Northing, Elevation: Target coordinates used

Refl. Ht.
Reflector height used for the target point

East, North, Elevation
Target coordinates used.

F1 Recalculate the result.

F2 Scroll to the measurements of the previous point.

F3 Scroll to the measurements of the following point.

F4 Measure more points. Return to the dialog "Target Point".

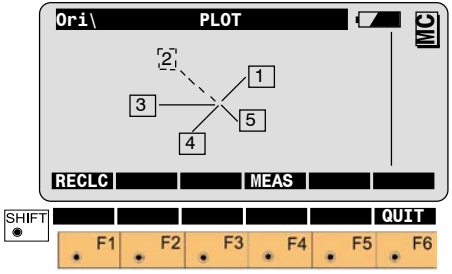
F5 Delete a point from the set of measurements. You can now measure a new point in its place.

F6 Return to the results dialog without changes.

SHIFT F6 Exit the program.

Plot

Generates a plot showing the measurement configuration.
The station point is in the center and the top of the sketch shows the direction of grid north. The sketch is true in angular but not true in distances.
Points are numbered sequentially in the order in witch they were measured.
Points not used in the calculation are marked with a dotted line.



F1 Recalculate the result and return to the dialog "CALCULATION RESULTS".

F4 Measure more points. The program will recall the "TARGET POINT" dialog.

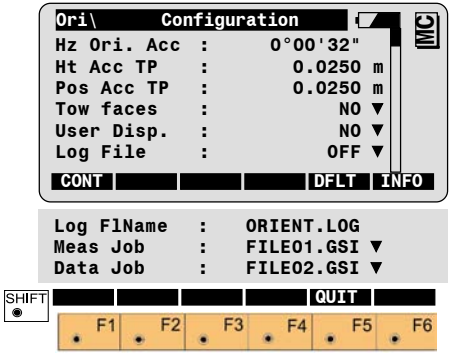
0 ... 9 Toggle any point ON or OFF by pressing the numeric key corresponding to the sequence number of the point.

Note, that 0 represents point 10.

Exit the program.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "TARGET POINT" dialog.



The "Configuration Editor "sets parameters for further program operations:

Hz Ori Acc
Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP
Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

Pos Acc TP
Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces
YES for dual-face measurement, NO for single-face.

User Disp
YES: The same display mask as the one used in the system measurement dialog (MEAS) is used for measurements with "Orientation and Height Transfer".

NO: The "Orientation and Height Transfer" default display applies.

Log File
ON, records measurements in a Log-File. The format is described in *chapter "Log file".*

Log FIName
Enter the Log File Name.

Meas. Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

F1 Store the current configuration and proceed to the dialog "TARGET POINT".

F5 Set the values to default.

F6 Displays date and version.

SHIFT F6 Exit the program.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

If **"Log File"** is set to **"ON"** the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record
For each measurement, a record will be stored containing:

- Station coordinates
- station height,
- orientation correction
- standard deviations for height and orientation correction

The residuals for:

- horizontal angles,
- heights and
- measured distances

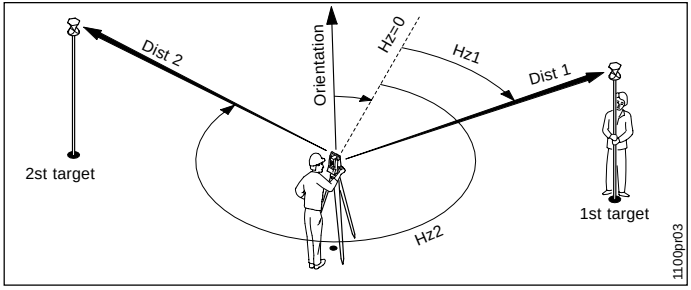
are also listed.

```
Leica Geosystems  Program Orientation and Height Transfer V 1.00
Instrument              :    TCA1103, Serial 102999
Meas. File              :    MYFILE.GSI
Program Start           :    20/04/1998 at 09:42

Station no.             :    2000
                             E= -0.0006m  N= -0.0002m  ELV= 398.3961m
                             hi= 1.6000m

Using Robust Solution

Station Elev.           :    398.3929m
Ori.Corr.               :    40'36"
S.Dev. Elev.            :    0.0035m
S.Dev. Orient.          :    0°00'04"

3 point(s) measured     :

##  Point no.        Δ Hz          Δ Height     Δ Distance     Error Flag
1   500          -0°00'55"        0.0026m       0.0020m          NONE
2   501          -0°00'48"        0.0044m       0.0016m          NONE
3   502           0°00'52"       -0.0070m      -0.0000m          NONE
```

Typical log file entry in the "Orientation and Height Transfer" program

Introduction

This manual describes the "Resection" program of the TPS1100 Professional Series.



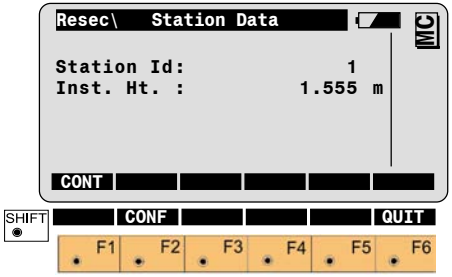
The program can be used to reduce the three-dimensional coordinates for the instrument station and the orientation of the horizontal circle from measurements to 2 target points with know Easting and Northing. To compute the position coordinates, at least the distances and the directions for both points are necessary.

For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known.

The program allows measurement in single or dual-face mode.

Station Data

Enter station point number and height of the instrument.

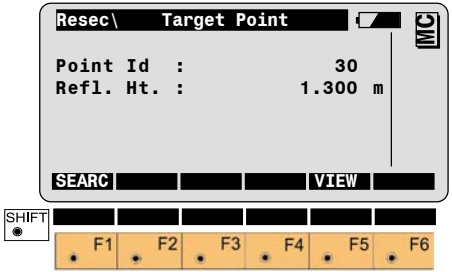


F1 Proceed to the dialog "Target Point".

SHIFT F2 Start the "Configuration".

Target Point

Enter the target point number and height of the reflector.

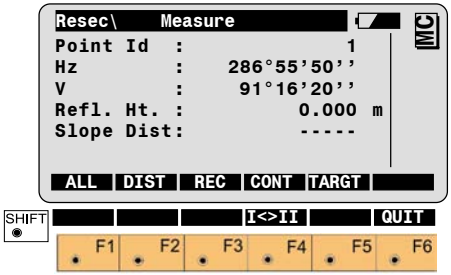


F1 Search the coordinates of the point entered from the active data job and go to the measure mode.

F5 Search and display the coordinates of the point found in the active data job.

Measure Mode

This dialog is similar to the TPS1100's basic "Measure Mode" dialog. Once a measurement is taken, the program will return to the dialog "Target Point" to acquire the next point for measuring.



F1 Simultaneously measure and record data in the active measurement job. Return to the dialog "TARGET POINT".

F2 Measure a distance.

F3 Record the measurement in the active measurement job. Return to the dialog "TARGET POINT".

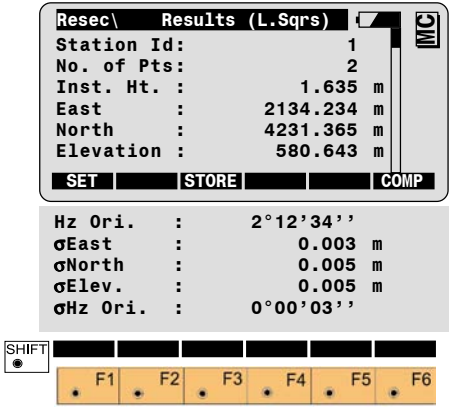
F4 Accept the measurement and return to the dialog "Target Point".

F5 Enter target data. (See User Manual)

SHIFT F4 Change the theodolite face.

SHIFT F6 Exit the program.

In this dialog the calculated station coordinates are shown with the orientation.



Station Id
Station point number

No. of Pts
Number of points measured

Inst.Ht.
Instrument Height

East
Calculated Easting for the station.

North
Calculated Northing for the station.

Elevation
Calculated elevation for the station

Hz Ori.
Oriented direction

σEast
Standard deviation of Easting

σNorth
Standard deviation of Northing

σElev
Standard deviation of the Elevation

σHz Ori.
Standard deviation of the Orientation

F1 Set orientation and station coordinates on the instrument.

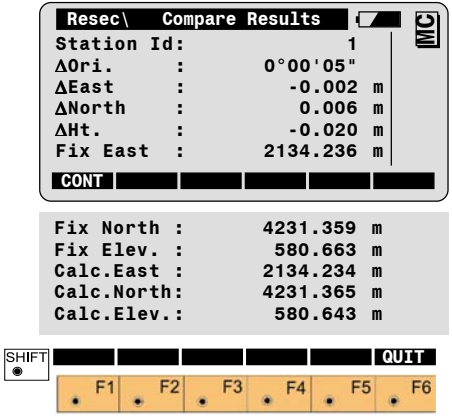
F3 Record the following results in the active measurement job:

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

F6 Compare the Resection results to the station coordinates and orientation currently set in the instrument.

SHIFT F6 Exit the program.

The comparison function compares the station coordinates and the orientation calculated by the program to the station coordinates and the orientation currently set in the instrument.



ΔOri
Orientation difference between the calculated orientation and the orientation set in the instrument.

ΔEast
Difference between the calculated Easting of the station and the Easting set in the intrument.
(Calc. East - Fix East)

ΔNorth
Difference between the calculated Northing of the station and the Northing set in the intrument.
(Calc.North - Fix North)

ΔHt.
Difference between the calculated Elevation of the station and the Elevation set in the intrument.
(Calc.Elev. - Fix Elev.)

Fix East
Easting coordinate of the station currently set in the intrument.

Fix North
Northing coordinate of the station currently set in the intrument.

Fix Elev.
Elevation of the station currently set in the intrument.

Calc. East
Easting coordinate of the station calculated with resection.

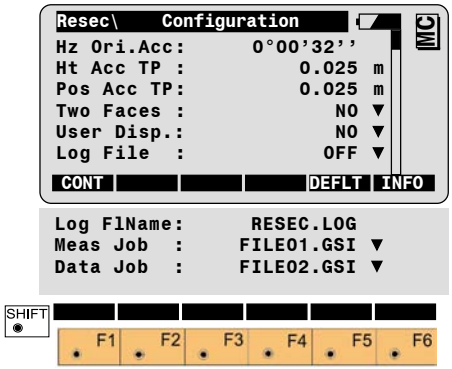
Calc.North
Northing coordinate of the station calculated with resection.

Calc.Elev.
Elevation of the station calculated with resection.

Return to the results dialog.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "Station DATA" dialog.



The "Configuration Editor" sets parameters for further program operations:

Hz Ori Acc
Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP
Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

Posn Acc TP
Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces
YES for dual-face measurement,
NO for single-face.

UserDisp.

YES The same display mask as the one used in the system measurement dialog (MEAS) is used for measurements with "RESECTION".

NO The "RESECTION" default display applies.

Log File

Set to **ON**, the program will record measurement data in a log file as described in *chapter "Log File"*.

Log FlName

Enter the Log File Name.

Meas. Job

Selection of the measurement job for recording measurements.

Data Job

Selection of the data job containing the fix point coordinates (control data).

F1 Store the current configuration and proceed to the dialog "STATION DATA".

F5 Set the value to the default

F6 Displays date and version.

SHIFT F6 Exit the program.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged.

These tolerances are used to avoid errors in target identification.

If exceeded an error message will be displayed.

If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record
For each measurement, a record will be stored containing:
Station coordinates and orientation correction, standard deviation for Easting, Northing, Height of station and orientation correction.
The residuals for horizontal angles, heights and measured distances are also listed.

```
Leica Geosystems  Program Resection V 1.00
Instrument              :    TCA1103, Serial 102999
Meas. File              :    MYFILE.GSI
Program Start           :    20/04/1998 at 09:42

Using Least-Squares Solution

Station no.             :    2000
                             E= -0.0011m  N= -0.0006m  ELV= 398.3951m
                             hi= 1.6000m

Ori.Corr.               ;    240°50'51"
S.Dev. East             :     0.0003m
S.Dev. North            :     0.0003m
S.Dev. Elev.            :     0.0047m
S.Dev. Orient.          :      0°00'49"

2 point(s) measured:

##  Point no.          Δ Hz        Δ Height        Δ Distance        Error Flag
1   500            -0°00'55"       0.0047m          0.0001m              NONE
2   501            -0°00'18"      -0.0047m          0.0002m              NONE
```

Typical log file entry in the "Resection" program

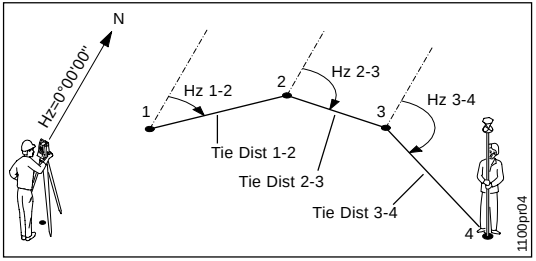
Introduction

This manual describes the "Tie Distance" program of the TPS 1100 Professional series.
The program calculates the length and azimuth of a line connecting two points.
Polygonal or Radial methods can be used as shown in the illustrations.

The data for the points can either be measured or retrieved from the selected data job. Measured points and points retrieved from the selected data job can be used together in the calculations, if the station coordinates and orientation are set correctly.

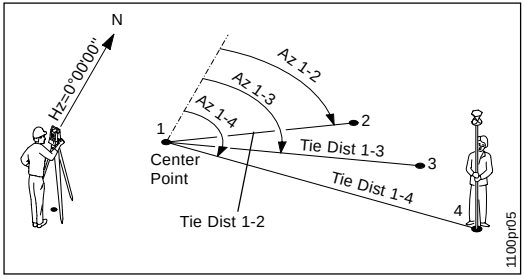
Polygonal Mode

In Polygonal Mode, the program will calculate the distance between the last two points measured (eg. Pt3 - Pt4).



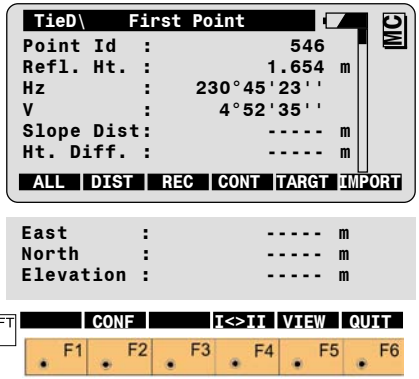
Radial Mode

In Radial Mode, the program will calculate the distance between the last point measured (called a Radial Point) (Pt2, Pt3 ...) and a fixed Center Point (Pt1).



Toggling between Polygonal and Radial Mode at any time while working is possible.

This dialog is used in accordance with the settings of the system function "Measure & Record" or according to the dialog shown below.


TieD\ First Point
Point Id : 546
Refl. Ht. : 1.654 m
Hz : 230°45'23''
V : 4°52'35''
Slope Dist: ----- m
Ht. Diff. : ----- m
ALL DIST REC CONT TARGT IMPORT
East : ----- m
North : ----- m
Elevation : ----- m
SHIFT CONF I<>II VIEW QUIT
F1 F2 F3 F4 F5 F6

The input for the start point is only possible after the program start or with the function F2 in the dialog "RADIAL MODE".
For all following points the program requests (NEXT POINT).
The dialog for the following points is identical with dialog above, except for the title.

F1 Simultaneously measure and record in the active measurement job. Proceed with the dialog "NEXT POINT". If the second point has already been measured, the program will proceed to the "Result" dialog.

F2 F3 Measure a distance. Record the measurement in the active measurement job and proceed with the dialog "NEXT POINT". If the second point has already been measured, the program will proceed to the "RESULT" dialog.

F2 F4 Measure the distance. Accept the measurement without recording. If the second point has already been measured, the program will proceed with the "RESULT" dialog.

F5 Enter the target data. (see User Manual)

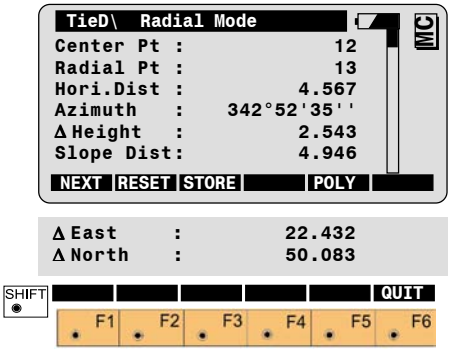
F6 Import target coordinates.

SHIFT F2 Start the "Configuration Editor".

SHIFT F4 Change the theodolite face.

SHIFT F6 Exit the program

This dialog shows the results computed from the last two points, which can be measured or retrieved from the active file. The same results are calculated for both methods. Using "Polygon Mode" the calculations are always based on the last two points, where as the "Radial Mode" always uses the first point as a reference point.



Center Pt.
Point number of the center point

Radial Pt.
Point number of the radial point

Hori.Dist
Horizontal distance between the two points

Azimuth
Azimuth from point 1 to point 2

Δ Height
Height difference between point 1 and point 2 (H2 - H1).

Slope Dist
Slope distance between the two points.

Δ East
Difference in Easting between point 1 and point 2 (E2 - E1).
The grid coordinates are only valid for oriented instruments set up on a known point.

Δ North
Difference Northing between point 1 and point 2 (N2 - N1).
Note, the grid coordinates are only relevant for oriented instruments set up on a known point.

F1 Return to the dialog "NEXT POINT" and measure the next point.

F2 Delete previous inputs. Proceed with the dialog "FIRST POINT" to enter a new reference point. This function is available for "RADIAL MODE" only.

F3 Record the following results in the active measurement job:

WI 11	Point number of point 2 or radial point number
WI 25	Azimuth from point1 to point 2
WI 35	Horizontal distance

WI 37 Height difference between point 1 and point 2
WI 39 Slope distance
WI 79 Point number of point 1 or center point number

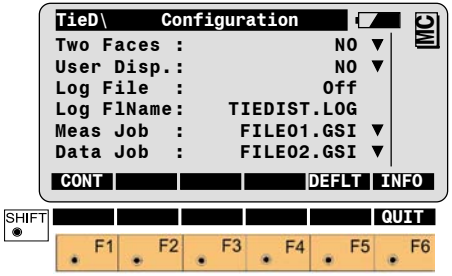
F5 Toggle between Radial/ Polygon Mode.

Configuration

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

Configuration Editor

SHIFT F2 Start the "Configuration Editor" from the "First Point" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces
YES for dual-face measurement,
NO for single-face.

User Disp

YES The same display mask as the one used in the system measurement dialog (MEAS) is used for measurements with "Tie Distance".

NO The "Tie Distance" default display applies.

Log File

Set to **ON**, the program will record measurement data in the Log File according to the format described on *chapter "Log File"*.

Log FlName

Enter the Log File Name.

Meas. Job

Selection of the measurement job for recording measurements.

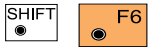
Data Job

Selection of the data job containing the fix point coordinates (control data).

Store the current configuration and proceed to the dialog "MEASURE MODE".

Set the values to default.

Displays date and version of the running application.



Exit the program.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record
For each measurement, a record will be stored containing :
Point No 1, Point No. 2, Hori. Dist., Azimuth, Δ Height, Slope Dist.

```
Leica Geosystems  Program Tie Distance V 1.00
Instrument        :  TCA1103, Serial 102999
Meas. File        :  MYFILE.GSI
Program Start     :  20/04/1998 at 09:42
Station no.       :  1151
                     E=    0.0000m       N=    0.0000m       ELV= 400.0000m
                     hi=   0.0000m
Point No.1        :  1020
                     E=  -31.2368m       N=  -0.2083m ELV=  400.0626m
Point No.2        :  1030
                     E=  -30.5679m       N=  -17.8404m       ELV=  403.1198m
Point no.1        :  1020
Point no.2        :  1030
Hori.Dist.        :   17.6448m
Azimuth           :  197°58'40"
ΔHeight           :  3.0572m
Slope dist.       :  17.9077m
Point No.2        :  1040
                     E=  -57.7040m       N=   -0.4265m       H=  400.1028m
Point No. 1       :  1030
Point No.2        :  1040
Hori.Dist.        :   32.2430m
Azimuth           :  336°32'14"
ΔHeight           :   -3.0170m
Slope dist.       :  32.3839m
```

Typical log file entry in the "Tie Distance" program (Polygonal Mode)

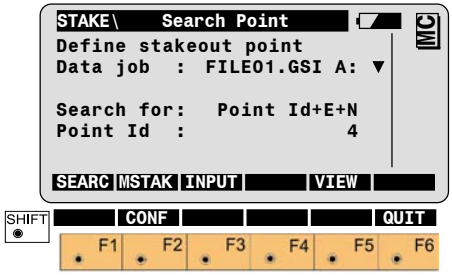
Introduction

This manual describes the "STAKEOUT" program of the TPS 1100 Professional series. The program is used to place marks in the field at predetermined points.

"STAKEOUT" requires the instrument to be set up on a known point with the instrument oriented. The station point can be determined also with the programs "FREE STATION" and "RESECTION".
The easting and the northing of the point to be staked must be known. The elevation is optional: the program permits selection of either 2D or 3D stakeout modes. It is also possible to stake out points given the azimuth and the distance from the station.
The points to be staked can either be retrieved from the selected data job or entered manually.

Search Point

The "SEARCH POINT" dialog informs about the active recording device, the active measurement job for data storage and the present point/code.


STAKE\ Search Point
Define stakeout point
Data job : FILE01.GSI A:
Search for: Point Id+E+N
Point Id : 4
SEARC MSTAK INPUT VIEW
SHIFT CONF QUIT
F1 F2 F3 F4 F5 F6

F1 Search the coordinates of the point entered in the active data job. Proceeds to the Coarse Positioning mode. Depending on the configuration of the stakeout method, the program may proceeds to the Stake mode.

F2 Manually enter the azimuth and the distance to the point to be staked.

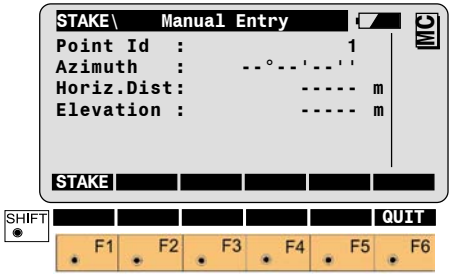
F3 Manually enter the stakeout point.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F2 Allows program configuration.

If the instrument is in LOCK-mode with EDM-mode TRK/RTRK and no Coarse Mode selected, pressing F1: SEARC starts the distance measurement.

Manual Stake allows to enter a point given the azimuth and the distance. The azimuth and the horizontal distance from the station to the point to be staked must be entered manually.



Point Id
point Id of the point to be staked.

Azimuth
Azimuth from the station to the point to be staked.

Horiz.Dist
Horizontal distance from the station to the point to staked.

Elevation
Elevation of the point to be staked.

F1 Confirms the entry and proceeds to the Coarse Positioning mode. Depending on the configuration of the stakeout method, the program may proceed to the Stake mode.

Once the coordinates of the stakeout point have been acquired, the program proceeds to "Coarse Positioning".

Coarse positioning is an optional step for approximate positioning, preceeding the iterative stakeout process. It may be used to direct the rod person from the point that has just been staked to the next point.

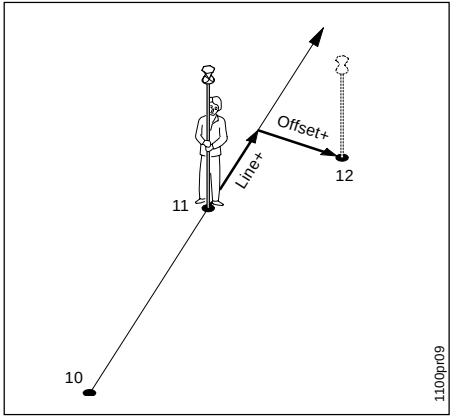
The "Coarse Positioning" calculates various displacements, depending on the selected mode.

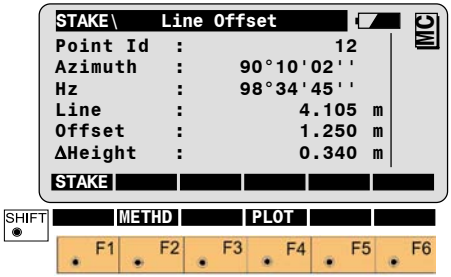
- Line Offset
- Orthogonal
- Azimuth and Distance

If instrument is in LOCK-mode with EDM-mode TRK/RTRK, pressing F1: STAKE from a Coarse Mode starts a distance measurement.

The stakeout values of each point are computed in relation to the base formed by the last two points.
If the elevation is known for the point to be staked out, the height difference in relation to the last base point (Pt2), is displayed. In particular, this method is advantageous for long objects (traffic routes).

Values for positioning are only displayed after two stakeout points.





Point Id
Point Id of the point to be staked.

Azimuth
Azimuth from the station to the point to be staked.

Hz
Present theodolite direction. Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

Line
Distance along the line defined by the last two points staked.

Offset
Orthogonal offset from the defined line.

ΔHeight
Height difference from the last point staked.

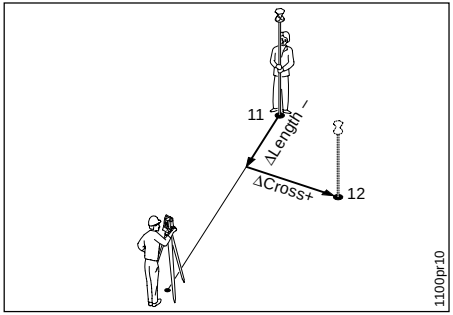
F1 Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be staked.

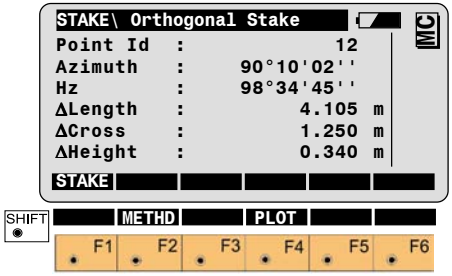
SHIFT F2 Change stakeout method. For more information refer to chapter "Select Stakeout Method".

SHIFT F4 Generate a plot of the stakeout data. For more information to chapter "Plot".

SHIFT F6 Exit the program.

Setting out values are computed as orthogonal coordinates to the baseline between instrument station and prism. If the elevation is also known, ΔH is given in relation to the last prism - point measured.
Note, data will be displayed if there is at least one point measured.





Point Id
Number of the point to be staked.

Azimuth
Azimuth from the station to the point to be staked.

Hz
Present theodolite direction. Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

ΔLength and **ΔCross** in relation to the baseline: last stakeout point - instrument station.

Δ Length
In-line distance **ΔLength** is positive for points further than the last prism position measured.

Δ Cross
Distance perpendicular to the baseline. **ΔCross** is positive for points on the right of the baseline.

Δ Height
Height difference from the last point measured.

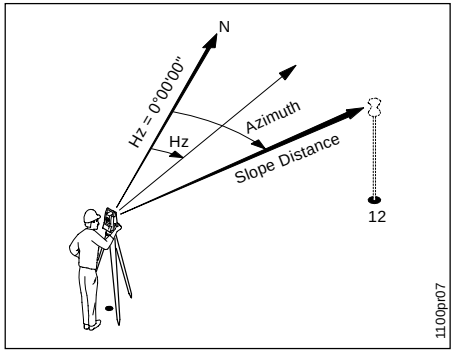
F1 Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be placed.

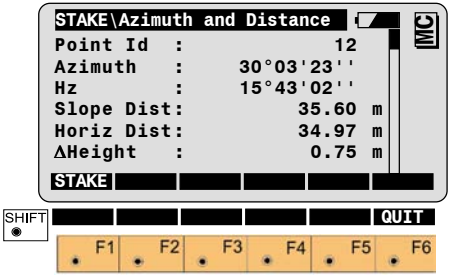
SHIFT F2 Change stakeout method.
For more information refer to *chapter "Select Stakeout Method".*

SHIFT F4 Generate a plot of the stakeout data.
For more information on *chapter "Plot".*

SHIFT F6 Exit the program.

This mode defines the point to be staked in terms of the azimuth and distance from the theodolite station to the point.





Point Id
Point Id of the point to be staked.

Azimuth
Azimuth from the station to the point to be staked.

Hz
Present theodolite direction.

Note, if the instrument is oriented and the azimuth and Hz angle are corresponding, the instrument is pointing to the point to be staked.

Slope Dist
Slope distance from the instrument station to the stakeout point.

Horiz. Dist
Horizontal distance from the instrument station to the stakeout point.

Δ Height
Height difference from the instrument station to the stakeout point.

F1 Proceed to "STAKEOUT". Motorized theodolites can drive the telescope to the horizontal and vertical direction of the point to be placed.

SHIFT F2 Change stakeout method.
For more information refer to chapter "Select Stakeout Method".

SHIFT F4 Generate a plot of the stakeout data. For more information to chapter "Plot".

SHIFT F6 Exit the program.

Polar Stakeout

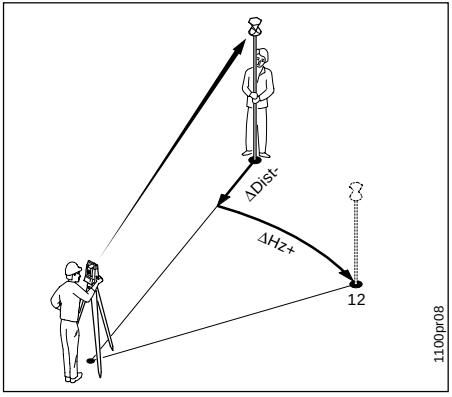
Various methods can be used, depending on the Stakeout Mode set.

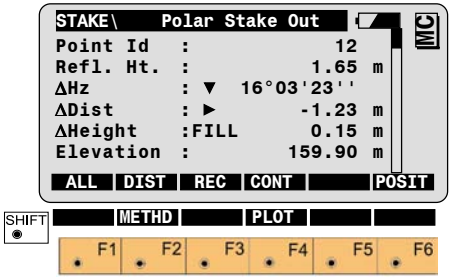
- Polar stakeout
- Orthogonal Stakeout
- Stakeout with auxiliary point
- Stakeout from Coordinates Differences (Grid coordinates)

For more information refer to chapter "Select Stakeout Method".
Motorized instruments can drive the telescope to the horizontal and vertical direction of the point to be staked.

After the first distance has been measured, the differences between calculated and measured direction and between calculated and measured horizontal distance are displayed.

If the elevation of the point to be staked is available, the height difference between the last measured reflector and the point to be staked is shown together with the measured elevation of the reflector point.





Values for ΔHz and ΔDist will be updated each time a new distance is measured.

Point Id
Point Id of the point to be staked.

Refl. Ht
Reflector height used at target point.

Δ Hz
Difference in Hz circle reading between the actual horizontal direction and the calculated direction.

Δ Dist
Difference in horizontal distance between the measured and calculated distance.

Δ Height
Difference in height between the measured reflector point and the stakeout point, expressed both numerically and as CUT/FILL.

Elevation
Elevation of the measured target point.

F1 Simultaneously measure and record data in the measurement job.

F2 Measure a distance.

F3 Record the measurement in the measurement job.

F4 Acquire the next point to stake.

F5 Enter target data.

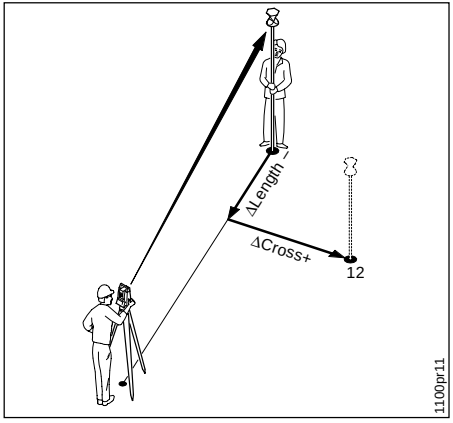
F6 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

SHIFT F2 Change stakeout method. For more information refer to chapter "Select Stakeout Method".

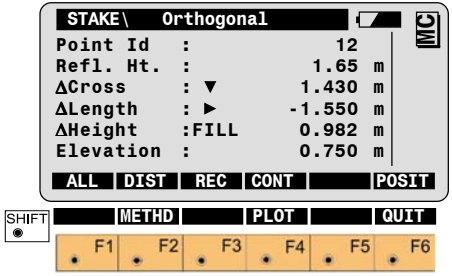
SHIFT F4 Generate a plot of the stakeout data. For more information refer to chapter "Plot".

SHIFT F6 Exit the program.

Orthogonal offsets are computed using the baseline between the last measured point and the instrument station.
After the first distance measurement, the transverse and longitudinal differences are displayed. If the elevation of the stakeout point is available, the height difference between the measured reflector and the point to be staked is shown, and also the measured elevation of the reflector point.



Values for ΔCross and ΔLength will be updated each time a new distance is measured.



Point Id
Point Id of the point to be staked.

Refl. Ht
Reflector height used at target point.

Δ Cross
Transversal displacement of the reflector. Positive in sign if point is right.

Δ Length
Longitudinal displacement of the reflector. Positive in sign if stakeout point is further away from station.

Δ Height
Difference in height between measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.

Elevation
Elevation of the measured reflector point.

F1 Simultaneously measure and record data in the measurement job.

F2 Measure a distance.

F3 Record the measurement data in the measurement job.

F4 Acquire the next point to stake.

F5 Enter target data.

F6 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

SHIFT F2 Change stakeout method. For more information refer to chapter "Select Stakeout Method".

SHIFT F4 Generate a plot of the stakeout data. For more information refer to chapter "Plot".

SHIFT F6 Exit the program.

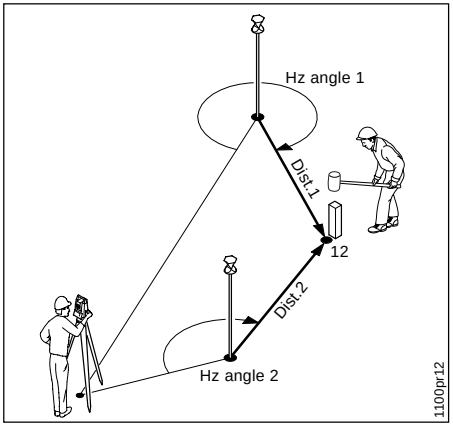
Stakeout with auxiliary points

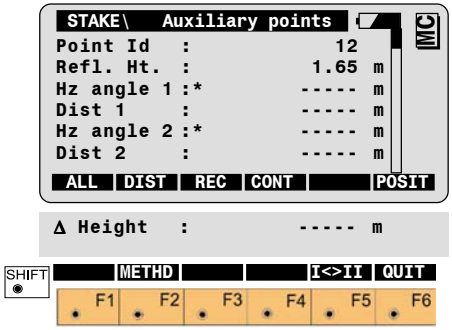
This mode computes values for points which cannot be sighted directly.

Measure to the auxiliary point Pt1. The distance "Dist 1" and angle "Hz angle 1" to the stakeout point are computed. Likewise proceed for auxiliary point Pt2. The stakeout point can be set out using the 2 calculated distances and/or angles from auxiliary points Pt1 and Pt2.

The program automatically updates both distance and angle values whenever a new point is measured. The previous point Pt2 becomes Pt1 and the new point Pt becomes Pt2.

Note, the auxiliary point to be measured will be marked with an asterisk (*).





Point Id
Point Id of the point to be staked.

Refl. Ht
Reflector height used at target point

Hz Angle 1
Angle from the first auxiliary point to the stakeout point.

Dist 1
Distance from the first auxiliary point to the stakeout point.

Hz Angle 2
Angle from the second auxiliary point to the stakeout point.

Dist 2
Distance from the second auxiliary point to the stakeout point.

Δ Height
Difference in height between the last measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.

F1 Simultaneously measure and record data in the measurement job

F2 Measure a distance.

F3 Record the measurement in the measurement job.

F4 Acquire the next point to stake.

F5 Enter target data.

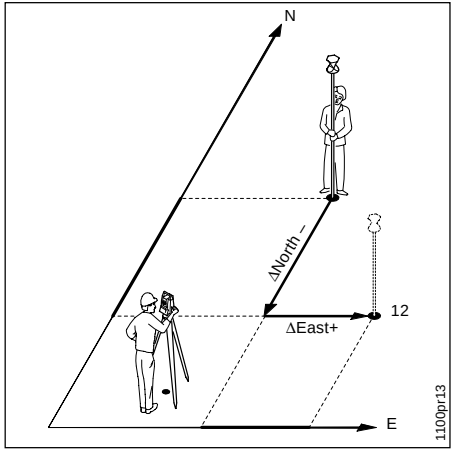
F6 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

SHIFT F2 Change stakeout method.
For more information refer to chapter "Select Stakeout Method".

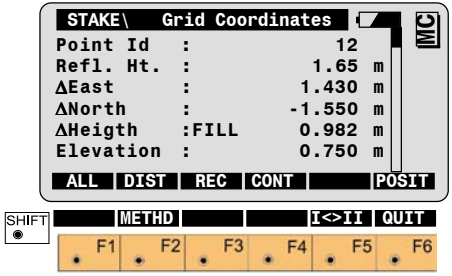
SHIFT F4 Generate a plot of the stakeout data. For more information refer to chapter "Plot".

SHIFT F6 Exit the program.

After the first distance measurement, the displacements along the grid coordinate axes are displayed. If the elevation of the point to be staked is available, the height difference between the measured reflector and the stakeout point is shown as well as the measured elevation of the reflector point.



Values for ΔEast and ΔNorth will be updated each time a new distance is measured.



Point Id
Point number of the point to be staked.

Refl. Ht
Reflector height used at target point

Δ East
Displacement of the reflector along the East-coordinate axis.

Δ North
Displacement of the reflector along the North-coordinate axis.

Δ Height
Difference in height between the measured reflector point and the stakeout point. Positive in sign if stakeout point is higher than the reflector position.

Elevation
Elevation of the measured reflector point.

F1 Simultaneously measure and record data in the measurement job.

F2 Measure a distance.

F3 Record the measurement in the measurement job.

F4 Acquire the next point to stake.

F5 Enter target data.

F6 Re-position the telescope on the target. Note, this function is only available for motorized theodolites.

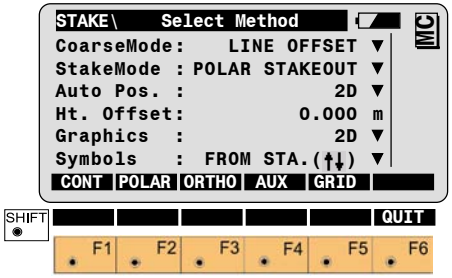
SHIFT F2 Change stakeout method.
For more information refer to chapter "Select Stakeout Method".

SHIFT F4 Generate a plot of the stakeout data. For more information refer to chapter "Plot".

SHIFT F6 Exit the program.

Select Stakeout Method

SHIFT F2 Select the stakeout method in any stakeout dialog.



Coarse Mode
Select the mode for "COARSE POSITIONING":

NONE	no Coarse mode used
LINE OFFSET	*see chapter "Line Offset"*
ORTHOGONAL	*see chapter "Orthogonal"*
AZIMUTH & DISTANCE	*see chapter "Azimuth and Distance"*

Choosing **NONE**, the program will automatically proceed to the selected "STAKEOUT METHOD" and bypass the "COARSE POSITIONIG" method after you selected a new stakeout point.

StakeMode
Select the mode for "STAKEOUT ":

POLAR STAKEOUT	*see chapter "Polar Stakeout"*
ORTHOGONAL STAKE	*see chapter "Orthogonal Stakeout"*
AUXILIARY POINTS	*see chapter "Stakeout with auxiliary points"*
GRID COORDINATES	*see chapter "Stakeout from Coordinate Differences"*

Auto Pos.
Select positioning method. (Motorized instruments only):

Off	Automatic positioning off
2D	Positioning of the horizontal drive
3D	Positioning vertical and horizontal drive

Ht. Offset
The height offset is added to the design elevations of the points to staked. CUT and FILL values refer to the elevations modified by the offset. The value can be changed only when you are in this dialog.

Graphics
Choose additional graphic displays: The graphics show the relative positions of the station (⌂), the reflector (+) and the required point (▯).

At the largest scale, the dimension of the graphics represents an actual value of about one metre. The scale is automatically altered in steps (5m, 20m etc.) in accordance with the distance of the reflector from the required point.

These graphics are particularly suitable for use in conjunction with the RCS1000 remote-control system. Depending on the particular application, the control unit at the target point can be moved towards the station or away from it, or orientated northwards or southwards. The direction from the current station (reflector) towards the required point is then the true one, and the required point can be quickly located by moving the reflector in the direction of the required point, as displayed in the graphics.

Following Graphics settings are possible:

• OFF:
No graphics are displayed.

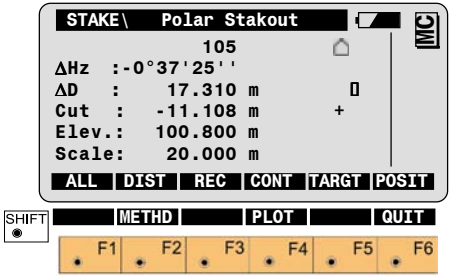
• From Station
The graphics are oriented from the instrument station to the point to be staked. This mode is recommended for guiding the rod person from the station.

• To Station
The graphics are oriented from the current reflector position to the station. This mode is adapted if working in the polar or orthogonal stakeout mode and in RCS mode.

• To North
The graphics are oriented to the North.
This mode is recommended for stakeout in RCS mode and in the grid coordinates mode.

• From North
The graphics are oriented to the South.
This mode is recommended for stakeout in RCS mode and in the grid coordinates mode.

Example: Polar Stakeout



These graphics appear after a distance measurement. No graphics of this type are available in the method “Setting out with help points”.

Symbols
Arrows may be used to guide the rod person to the point to be staked.

Select the display mode of symbols in the stakeout dialog:

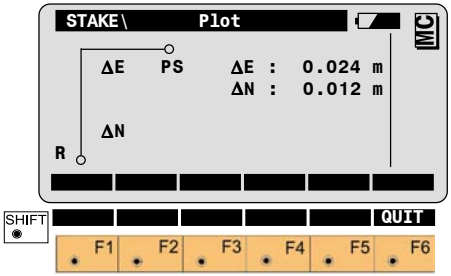
- **From Sta. (▼▲)**
Guidance of the rod person from the instrument station.

- **To Sta. (▲▼)**
Guidance at the rod, in relation to the instrument station
(e.g. if working in RCS mode).

- **NONE**
Symbols are not used.

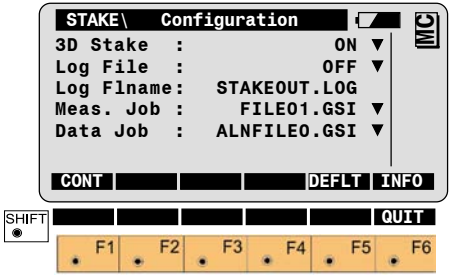
A plot is generated of the stakeout situation with display of the stakeout values, corresponding to the "STAKEOUT METHOD".

Note, below a typical plot is shown using the coordinate "STAKEOUT METHOD".



Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "SEARCH POINT" dialog.



The "Configuration Editor" sets parameters for further program operations:

3D Stake

ON for 3-dimensional stakeout. Note the program will not perform 3D stakeout if no elevation is available for the point to be staked.

OFF for 2-dimensional stakeout. Note that there will be no difference in height displayed.

Log File

OFF no recording in a Log file

SHORT reduced recording in a Log file

LONG detailed recording in a Log file

Meas. Job

Selection of the measurement job for recording measurements.

Data Job

Selection of the data job containing the fix point coordinates (control data).

F1 Store the current configuration and proceed to the dialog "SEARCH POINT".

F5 Set the value to default. (3D stake = **ON**).

F6 Display software-version

SHIFT F6 Exit the program.

If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header

The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record

SHORT recording of design coordinates, setout height and height difference in the log file.

```
Leica Geosystems  Program Stakeout V1.00
Instrument      :  TCA1103, Serial 102999
Meas. File      :  MYFILE.GSI
Program Start   :  24/04/1998 at 18:26

Station         :  1
                   E=100.000m   N=100.000m     H=40.000m        hi=1.560m
Point           :  3, Ht. Offset = 0.000m

Design          :  E=100.809m   N=103.346m     H=39.840m
                   sH=39.861m   dh= -0.021m     hr=1.700m
```

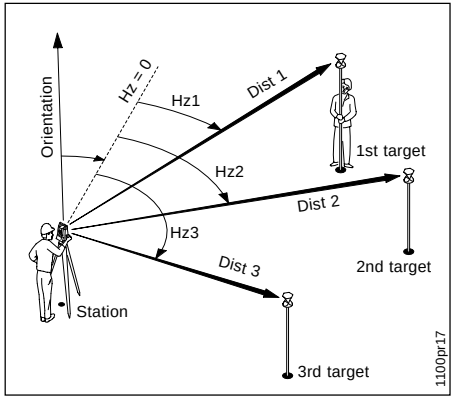
LONG recording of design coordinates, setout coordinates and differences of coordinates in the log file.

```
Leica Geosystems  Program Stakeout V1.00
Instrument      :  TCA1103, Serial 102999
Meas. File      :  MYFILE.GSI
Program Start   :  24/04/1998 at 18:28

Station         :  1
                   E=100.000m   N=100.000m     H=40.000m        hI=1.560m
Point           :  3, Ht. Offset = 0.000m
Design          :  E=100.809m   N=103.346m     H=39.840m
Staked          :  E=100.807m   N=103.344m     H=39.851m        hr=1.700m
Deltas          :  dE=0.002m      dN=0.002m     dH0-0.011m
```

Typical log file entries in the "STAKEOUT" program

Introduction

This manual describes the "FREE STATION" program of the TPS1100 Professional series.



This program can be used to deduce the three-dimensional coordinates for the instrument station and the horizontal orientation of the from measurements to a maximum of 10 target points.

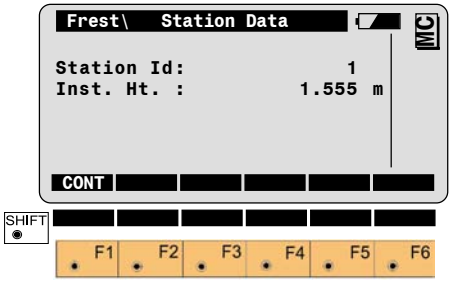
For simultaneous determination of the station elevation, height of instrument and height of reflector must already have been input and the elevation of the target points must be known.

You may use target points with elevation only.

The program allows measurement in single or dual-face mode.
Directions to target points can be determined, as can any combination of direction and distance. To compute the position coordinates, at least three elements (2 directions and 1 distance) are necessary.

Station Data

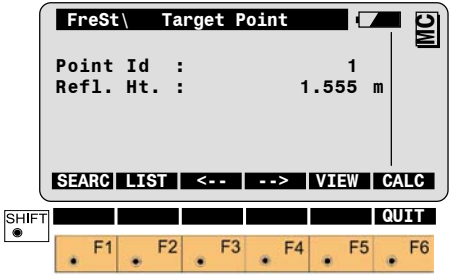
Enter station point number and height of the instrument.



F1 Proceed to define the target points.

SHIFT F2 Start the "CONFIGURATION"

Enter the target point number and height of the reflector.



F1 Search the coordinates of the target point from the coordinates of the point entered in the active data job and go to the measure mode.

F2 Define a list of target points and the measurement sequence. For further use: selection of points from the list is possible.

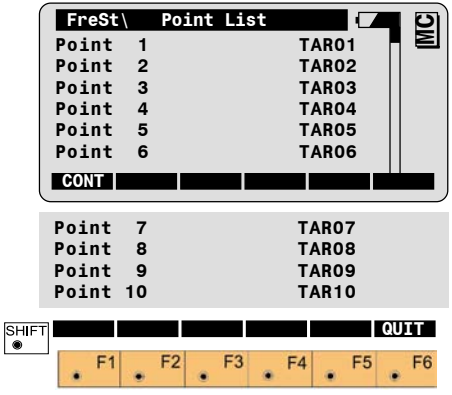
F3 Displays the previous point from the list of points you entered. Note that this key will not be available until there is at least one point in the list.

Displays the next point in the list of points you entered. Note that this key will not be available until there is at least one point in the list.

F5 Search and display the coordinates of the point found in the active data job.

F6 Run the calculation. Note, the key F6 will be assigned after sufficient measurements were taken to calculate a position.

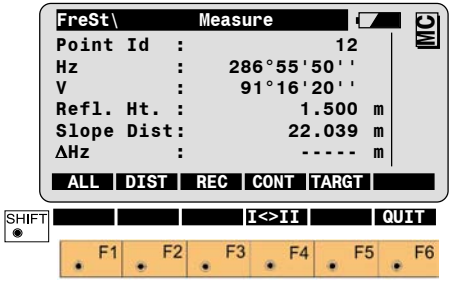
Enter a maximum of 10 points. The same point can be retrieved several times.
The same point number can be used several times without new input.



F1 Return to dialog "Target Point"

This dialog is similar to the TPS1100's basic "MEASURE MODE" dialog. Once a measurement is taken, the program will return to the dialog "Target Point" to acquire the next point for measuring.

If the station coordinates can be calculated successfully from the first few measurements, the ΔHz and ΔV values are displayed for further entered target points. Motorized theodolites will automatically drive the telescope to the target point.



F1 Simultaneously measure and record data in the active measurement job. Return to the dialog "TARGET POINT".

F2 Measure a distance.

F3 Record the measurement in the active measurement job. Return to the dialog "Target Point".

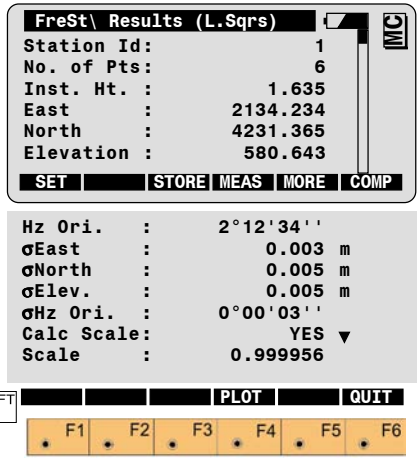
F4 Accept the measurement and return to the dialog "TARGET POINT".

F5 Enter target data. (see User Manual)

SHIFT F4 Change the theodolite face.

SHIFT F6 Exit the program.

Calculates the 3D station coordinates and orientation as well as the standard deviation of the results.



Station Id
Point number assigned to the station

No. of Pts
Number of points measured

Inst.Height
Instrument Height

East
Calculated Easting for the station

North
Calculated Northing for the station

Elevation
Calculated Elevation for the station

Hz. Ori
Oriented direction

σ East
Standard deviation of Easting

σ North
Standard deviation of Northing

σ Elev
Standard deviation of the Elevation

σ Hz. Ori
Standard deviation of the Orientation

Calc Scale
YES scale factor is calculated,
NO scale factor is not calculated
Note that this parameter is displayed only if sufficient measurement were taken.

Scale
The scale factor of the free station calculation.
Note that the scale is not shown if set to NO.

F1 Set orientation and station coordinates on the instrument.

F3 Record the following results in the active measurement job:

WI 11	Station Point Number
WI 25	Orientation correction
WI 84	Station Easting
WI 85	Station Northing
WI 86	Station Elevation
WI 87	Last reflector height used
WI 88	Instrument Height

F4 Measure more points. The program will recall the "TARGET POINT" dialog.

F5 Show the results of individual measurements on the screen (see dialog "More Information").

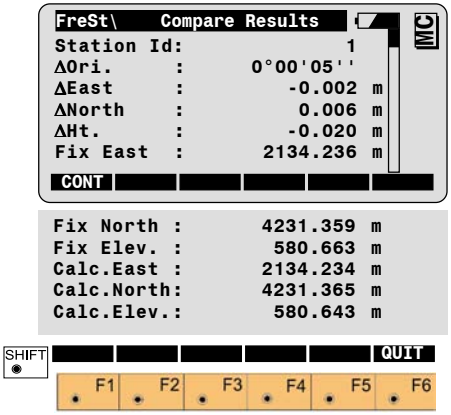
F6 Compare the Free Station results to the station coordinates and orientation currently set in the instrument.

SHIFT F2 Select between the "Robust" method and the Least Squares method.

SHIFT F4 Sketch of the station and the reference points used.

SHIFT F6 Exit the program.

The comparison function compares the station coordinates and the orientation calculated by the program to the station coordinates and the orientation currently set in the instrument.



ΔOri
Orientation difference between the calculated orientation and the orientation set in the instrument.

ΔEast
Difference between the calculated Easting of the station and the Easting set in the intrument. (Calc. East - Fix East)

ΔNorth
Difference between the calculated Northing of the station and the Northing set in the intrument. (Calc.North - Fix North)

ΔHt.
Difference between the calculated Elevation of the station and the Elevation set in the intrument. (Calc.Elev. - Fix Elev.)

Fix East
Easting coordinate of the station currently set in the intrument.

Fix North
Northing coordinate of the station currently set in the intrument.

Fix Elev.
Elevation of the station currently set in the intrument.

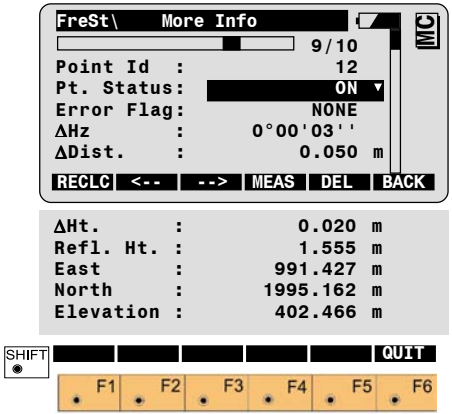
Calc. East
Easting coordinate of the station calculated with resection.

Calc.North
Northing coordinate of the station calculated with resection.

Calc.Elev.
Elevation of the station calculated with resection.

Return to the results dialog.

Display the residuals of individual measurements. You can also disable points from the calculation of position or height as well as delete erroneous measured points.



9/10
Sequence number of the current point and total number of points in the measurement set. The scroll bar shows the sequential position of the measurements, graphically.

Point Id
The target point number.

Pt. Status
ON Measurements to target point used for calculation.
Ignore Elev.
Target point elevation disabled: measurements for elevation determination not used in calculation.
OFF Target point disabled: measurements to point NOT used for calculation.

Error Flag
Identified erroneous measurements. Possible values are:
NONE measurement is OK
HZ horizontal angle error
DIST distance error
HT height difference error
The flags may also be combined, i.e. DIST + HZ

Δ Hz.
Difference between calculated and measured Hz. angle

Δ Dist
Difference between calculated and measured distance

Δ Ht
Difference between calculated and measured height

Refl. Ht.
Reflector height used for that target point

East, North, Elevation
Target coordinates used.

F1 Recalculate the result.

F2 Scroll to the measurements of the previous point.

Plot

F3 Scroll to the measurements of the following point.

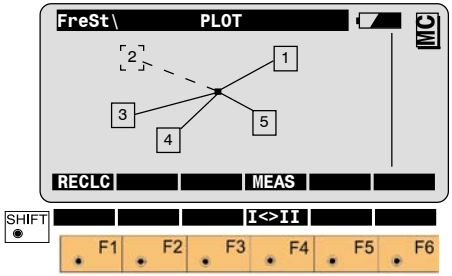
F4 Measure more point. Return to dialog "Target Point".

F5 Delete a point from the set of measurements . You can now measure a new point in its place.

F6 Return to the results dialog without changes.

SHIFT F6 Exit the program.

Generates a plot showing the measurement configuration. The station point is in the center and the top of the sketch shows the direction of Grid north. The sketch is true in angular but not true in distances. Points are numbered sequentially in the order in which they were measured. Points not used in the calculation are marked with a dotted line.



F1 Recalculate the solution and return to the dialog "RESULTS".

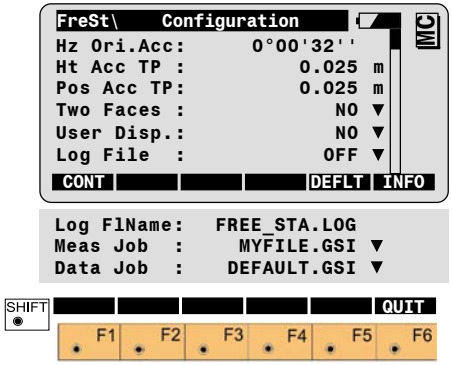
F4 Measure more points. The program will recall the "TARGET POINT" dialog.

0 ... 9 Toggle any point ON or OFF by pressing the numeric key corresponding to the sequence number of the point.

Note, that 0 represents point 10.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

Start the "Configuration Editor" from the "**STATION DATA**" dialog.



The "Configuration Editor" sets parameters for further program operations:

Hz Ori Acc
Limit for the standard deviation of the orientation. The orientation is regarded as "error free", if the computed standard deviation of the orientation is within twice the entered value.

Ht Acc TP
Height accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The height is regarded as "error free", if the computed standard deviation is within twice the entered value.

Posn Acc TP
Position accuracy of the target points. The entered value, is used as an "a priori" accuracy in the calculation. The position is regarded as "error free", if the computed standard deviation is within twice the entered value.

Two Faces
YES for dual-face measurement,
NO for single-face.

User Disp

YES The same display mask as the one used in the system measurement dialog (MEAS) is used for measurements with "Free Station".

NO The "Free Station" default display applies.

Log File

ON, records measurements in a Log-File.The format is described on chapter Log File.

Log FlName

Enter the Log File Name

Meas. Job

Selection of the measurement job for recording measurements.

Data Job

Selection of the data job containing the fix point coordinates (control data).

F1 Store the current configuration and proceed to the dialog "STATION DATA".

F5 Set the values to default.

F6 Display software-version

SHIFT F6 Exit the program.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record
For each measurement, a record will be stored containing :
- Station coordinates and
- orientation correction,
- standard deviations for
  Easting,
  Northing,
  Height of station
  and orientation correction.

The residuals for
- horizontal angles,
- heights and
- measured distances

are also listed.

```
Leica Geosystems  Program Free Station V 1.00
Instrument            :   TCA1103, Serial 102999
Meas. File            :   MYFILE.GSI
Program Start         :   20/04/1998 at 09:42
Using Least-Squares Solution

Station no.           :   200
                          E= -3.5461m    N= -0.7683m   ELV= -0.6518m   hi= 0.0000m

Ori.Corr.             :   0°00'20"
S.Dev. East           :   0.0003m
S.Dev. North          :   0.0003m
S.Dev. Elev.          :   0.0015m
S.Dev. Orient.        :   0"00'02"

4 point(s) measured   :

##  Point no.          d Hz          d Height      d Distance      Error Flag
1   109              0°01'21"        0.0012m       -0.0000m          NONE
2   110             -0°00'00"       -0.0045m       -0.0002m          NONE
3   112             -0°00'25"        0.0018m        0.0010m          NONE
4   113              0°00'48"        0.0014m       -0.0002m          NONE
```

Continued next page

```
Using Robust Solution

Station no.          :  200
                        E=  -3.5461m  N= -0.7683m     ELV= -0.6518m     hi= 0.0000m
Ori.Corr.            :  0°00'20"
S.Dev. East          :  0.0003m
S.Dev. North         :  0.0003m
S.Dev. Elev.         :  0.0015m
S.Dev. Orient.       :  0°00'02"

4 point(s) measured :

##  Point no.          d Hz          d Height      d Distance    Error Flag
1   109              0°01'21"        0.0012m       -0.0000m        NONE
2   110             -0°00'00"       -0.0045m       -0.0002m        NONE
3   112             -0°00'25"        0.0018m        0.0010m        NONE
4   113              0°00'48"        0.0014m       -0.0002m        NONE
```

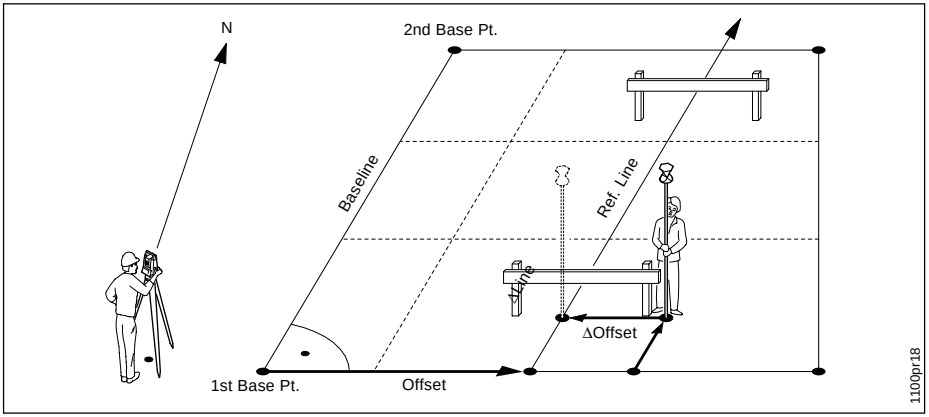
Typical log file entry in the "FREE STATION" program

Introduction

This manual describes the "Reference Line" program of the TPS1100 Professional series.

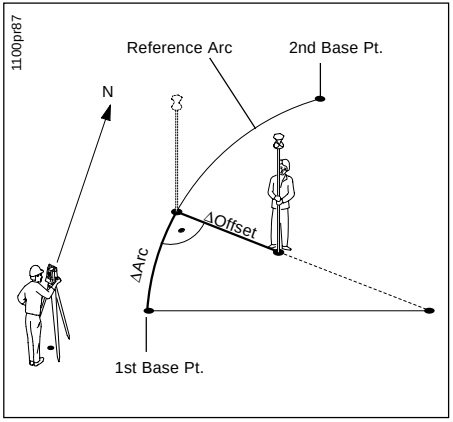
"REFERENCE LINE" is a specialized form of stakeout used for construction and building alignment. It permits positioning of a point referred to a line or an arc. Points for use in the program can be measured, entered manually, or read from the selected measurement job.
The program records individual measurements in the database. In addition, the program generates a log file containing all data for a given measurement session.

For three dimensional positioning, the program calculates height differences between the target point and a reference elevation.



Depending on the configuration settings, the reference elevation for the reference line can be a constant elevation or an interpolated reference elevation. For reference arcs only constant elevations are possible.

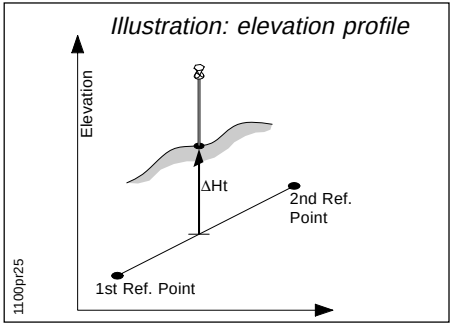
Points with known offsets from the reference line or arc can be staked out with the function "Line and Offset".
The function is accessible from the "Define Reference Line/Arc" dialog.



Constant reference elevation

For the configuration **Ref.Elev. = 1st Base Point**, the reference elevation for the calculation of ΔHeight values is the elevation of the 1st base point. The ref. elevation can be modified by specifying a height offset **(Ht.Offset)** in the “Define Reference Line” dialog. With **Edit Elev.** the height of each point can be changed separately (see Config. Dialog).

Illustration: elevation profile



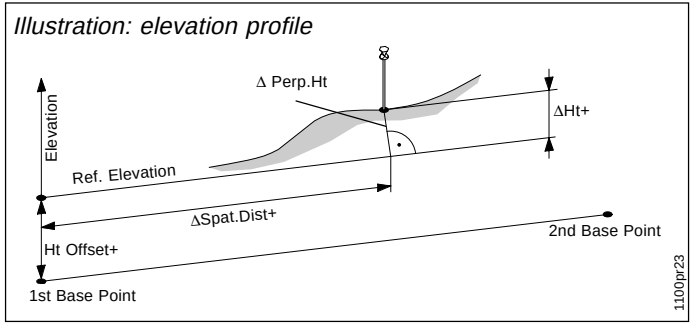
Ht Offset
Offset of the reference elevation in relation to the first base point.

Δ Ht
Height difference between the target point and the reference elevation.

Interpolated reference elevation

For the configuration **Elev. Ref. = Baseline**, the reference elevation for the calculation of ΔHt values is the elevation of the baseline at the reflector position.
You can modify the reference elevation by specifiying a height offset **(Ht.Offset)** in the dialog for the definition of the reference line.

Illustration: elevation profile



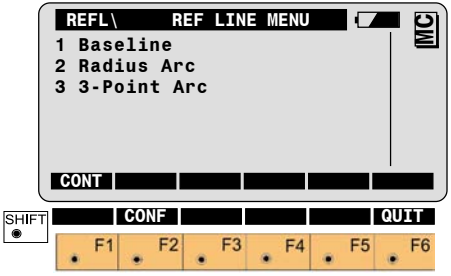
Ht Offset
Offset of the reference elevation in relation to baseline.

Δ Ht
Height difference along the vertical between the target point and the reference elevation.

Δ Perp.Dist
Height difference between the target point and the reference elevation, perpendicular to the reference elevation.

Δ Spat.Dist
Line Offset along the reference elevation.

The base method is selected in the Menu dialog.



Baseline
Line defined by two points.

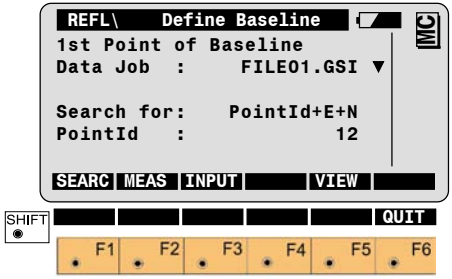
Radius Arc
Arc defined by two points and a radius.

3-Point Arc
Arc defined by three points.

Line of sight to the points is not necessary, since they can be imported from a data file.

Determine Base Points

This dialog defines the two points of the baseline. You can either manually enter, measure or search for the point in the database.



The dialogs to enter the Arc points are the same and will not be described here.

F1 Search the coordinates of the point entered in the active data job.

F2 Proceed to determine the base base point by a measurement.

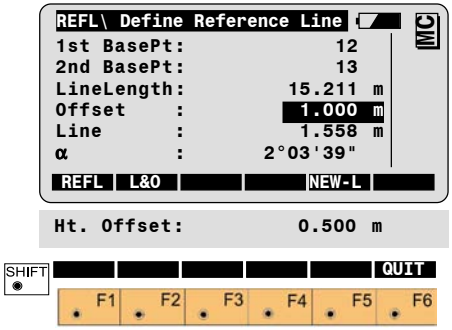
F3 Manually enter the first base point.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

The reference line can be defined by entering a distance value, a line offset value and an angle value for the base line. Heights can be changed by a constant rate (eg, 1m) by entering a Ht offset value.
With Edit Elev. the height of each point can be set separately.

"Line and Angle" values cannot be set for reference arcs.



1st BasePoint
The first base point that defines the base line.

2nd BasePoint
The second base point that defines the base line.

LineLength
Entire length of Baseline.

Offset
Establishes the displacement parallel to the base line. For Arcs the offset is radial and applied to each point separately, arcs are not "shifted".

Line
Establishes the distance from the first reference point to the starting point of the new reference line.

Alpha
Establishes the angle between the base line and the new reference line.

Ht Offset
Displaces the base line parallel in height.

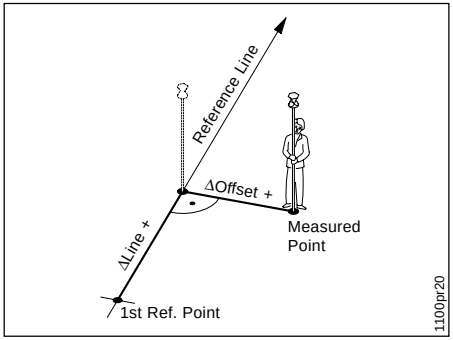
F1 Accept parameters as displayed and proceed to the "REF LINE RESULTS" dialog.

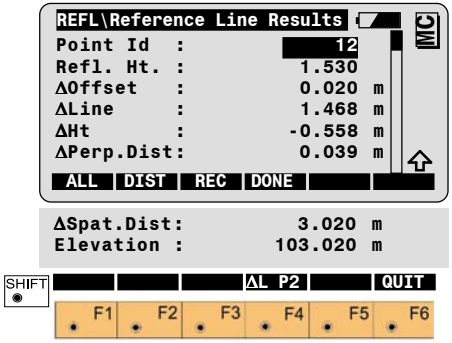
If instrument is in LOCK-mode with EDM-mode TRK/ RTRK, distance measurement is started.

F2 Go to "Line & Offset" and stakeout points with known offset values from reference.

F5 Return to Menu to define a new Base Line/Arc.

The “Reference Line Results” dialog displays the data of the measured point referring to the reference line, as shown below:





Point Id
The point number of the stakeout point.

Δ Offset
Perpendicular Offset:
Δ Offset+: To the right of the reference
Δ Offset-: To the left of the reference

Δ Line (or ΔArc)
Line offset from the first Ref. Point
Δ Line+: in the line direction
Δ Line-: in the opposite direction of the line.

ΔL from P2 (or ΔA from P2)
(only for configuration Line/α = OFF)
Line offset from the 2nd Ref. Point
ΔL P2+: in the direction of the line
ΔL P2-: in the opposite direction of the line (P2 -> P1).

Δ Ht
Edit Elev.= OFF: Height difference along the vertical between the target point and the reference elevation.
Edit Elev. = ON: Height difference between entered and measured elev.

Δ Perp.Dist
(only for configuration Ref.Elev. = Baseline. Not available for Arc)
Height difference between the target point and the reference elevation, perpendicular to the reference elevation.

Δ Spat.Dist
(only for configuration Ref.Elev. = Baseline. Not available for Arc)
Line Offset along the reference elevation.

Elevation:
Edit Elev. = OFF
Elevation of the measured point.

DesignElev.
Edit Elev. = ON
Elevation entered by user.

Simultaneously execute distance measurement and record the measurement.

Measure a distance.

Record the measurement in the measurement file.

Depending on the setting in the "Configuration" dialog a measurement block containing delta values is recorded:

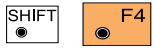
WI 11	Point Number of target
WI 35	Δ Offset
WI 37	Δ Ht
WI 39	Δ Line

or

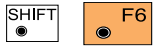
WI 11	Point Number of target
WI 35	Δ Offset
WI 37	Δ Perpendicular
WI 39	Δ Spatial distance

Depending on the settings in the "Configuration" dialog a log-file is also generated.

Return to "Define Reference Line" dialog.



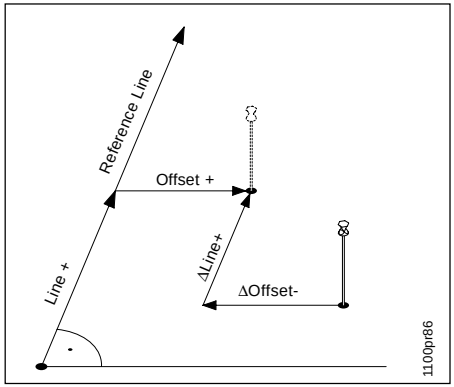
Display ΔLine from P2.

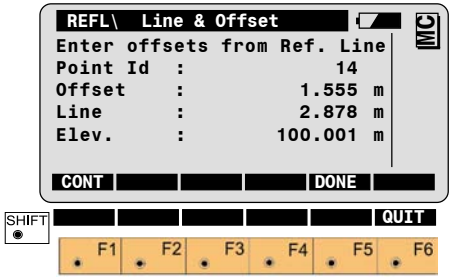


Exit the program.

Enter L&O values

Line and Offset is started from the "Define Reference Line/Arc" dialog. Points with known offset values from the reference can be staked out with this function.





Point Id
Point number of the point to be staked.

Offset
Perpendicular offset of the point to be staked.
Offset +: to the right of the reference
Offset - : to the left of the reference.

Line (or Arc)
Line offset from first point, along reference.
Line +: in the direction of the line.
Line - : in the opposite direction of the line.

DesignElev
Elevation of the point to be staked.

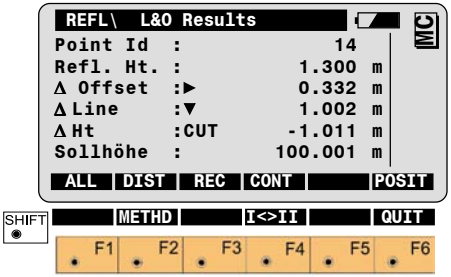
F1 Continue to "L&O Results" dialog.

If instrument is in LOCK-mode with EDM-mode TRK/RTRK, distance measurement is started.

F5 Return to "Define Reference Line" dialog.

SHIFT F6 Exit the program.

The results dialog displays the differences between entered and measured data. There are two methods to choose from: Orthogonal and Polar. *For more information refer to chapter "Method Dialog".*



Point Id
Point number of the point to be staked.

Refl. Ht.
Reflector height used at target.

Δ Offset
(orthogonal stakeout)
Difference in transversal displacement between actual and calculated point.

\+ : point is further to the right
\- : point is further to the left

Δ Line
(orthogonal stakeout)
Difference in longitudinal displacement between actual and calculated point along reference.
\+ : point is further along the reference
\- : point is closer to beginning of ref.

Δ Hz
(polar stakeout)
Difference in Hz between actual and calculated direction.

Δ Dist
(polar stakeout)
Difference in horizontal distance between actual and calculated values.

Δ Ht
Difference between design and measured elevation. Expressed both numerically and as CUT/FILL.

Elev.
Edit Elev. = OFF
Elevation of the measured point.

DesignElev.
Edit Elev. = ON
Elevation entered by user.

F1 Simultaneously execute distance measurement and record the measurement.

F2 Measure a distance.

F3 Record the measurement in the measurement job.

F4 Return to previous L&O dialog without recording data.

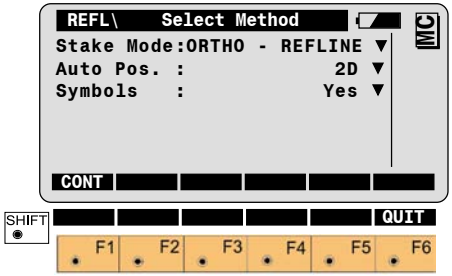
F6 (Re-)position the telescope on the target point. Note: this function is only available for motorized instruments.

SHIFT F2 Open "Method" dialog to change settings.

SHIFT F4 Change instrument face.

SHIFT F6 Exit the program.

SHIFT F2 Open "Method" dialog from "L&O Results" dialog.



Stake Mode
Select the stakeout mode.

ORTHOGONAL TO REFLINE
Differences between entered and measured Offset values are displayed after the first distance measurement.

ORTHOGONAL TO STATION
Displays orthogonal values based on the line defined by instrument station and reflector position.

POLAR STAKEOUT
Displays differences between calculated and measured direction and horizontal distance after first distance measurement.

Auto Pos.
Select positioning method.
(Motorized instruments only):

Off Automatic positioning off.

2D Positioning of the horizontal drive.

3D Positioning of the vertical and horizontal drive.

Symbols
Arrows can be used to guide the rod person to the point to be staked.
The available symbols depend on the selected method.

- **NO**
  Symbols are not used.

Ortho - RefLine

- **YES**
  Symbols guide the rod person along the reference.

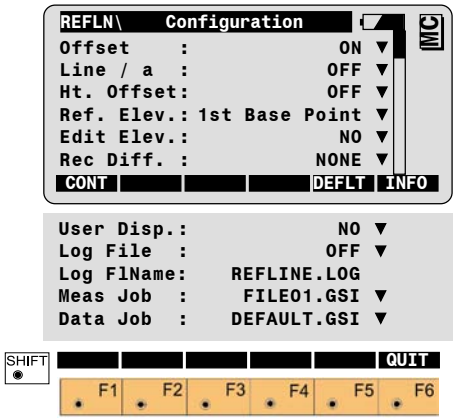
Ortho - Station/Polar Stakeout

- **TO STA. (↓↑)**
  Guidance at the rod, in relation to the instrument station.

- **FROM STA. (↑↓)**
  Recommended to guide rod person from instrument station.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "**Reference Line Menu**" dialog.



The "Configuration Editor" lets you change and set the following parameters that determine program operation:

Offset
Set to **ON**, the program will allow the input of an offset from the reference line.

Line / α
Set to **ON**, the program will allow the input of a distance from the first base point to the starting point of the new reference line, and also an angle between the base line and the new reference line.

Ht Offset
Set to **ON**, the program will allow the input of a height offset.

Ref. Elev.
To define the reference elevation for the calculation of the height offset.

In order to change the setting for Ref. Elev., the parameter **Line/α** must be turned **OFF**.

Ref. Elev. = 1st Base Point
The reference elevation is the elevation of the first base point.

Ref. Elev. = Baseline
The reference elevation is the elevation of the baseline at the intersection point with the vertical through current reflector position.

Edit Elev.
Set to **YES**, point elevations can be edited directly in "Reference Line Results" and "L&O Results" dialogs. Δ Ht is the difference between entered and measured values and is updated automatically.

Rec Diff
Set to **NONE**, no additional measurement is recorded.
Set to **O** the program will record Δ Offset values only.
Set to **O**/ L, the program will record both Δ Offset and Δ Line values.
Set to **O/L/H**, the program will record Δ Offset, Δ Line and Δ Height of target values.

If the option "**Ref. Elev.**" is set to "**Baseline**" you can in addition calculate the values:
Set to **O/S** the program will record both Δ Offset and Δ Spatial distance values.
Set to **O/S/P**, the program will record Δ Offset, Δ Spatial distance and Δ Perp. Dist of the perpendicular line. (*Refer to figure in chapter Reference elevation*)

User Disp
Set to **YES**, the display defined in the MEAS application will be used.
If set to **NO**, the "REFERENCE LINE" default display applies.

Log File
Set to **ON**, the program will record measurement data in a log file in the format described on chapter Log File.

Log FlName
Enter the Log File Name.

Meas. Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

Store the current configuration and proceed with dialog "1st Point of Baseline".

Press to reset configuration parameters to their default values.

Displays date and version of the running application.

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as dateand time.

Configuration
Each modification of baseline and reference line is stored.

Record
For each measurement, a record will be stored containing: Point No., as-staked Easting, Northing, and Elevation and their delta values.

```
Leica Geosystems  Program Reference Line V 1.00
Instrument      :  TCA1103, Serial 102999
Meas. File      :   MYFILE.GSI
Program Start   :  20/04/1998 at 09:42

Station no.     :  Stationpointnumber
                   E=1000.000m   N=2000.000m   H=400.000m    hi=1.1150m

1.BasePoint     :  Baselinepointnumber
                   E=1050.000m   N=2050.000m   H=410.000m

2.BasePoint     :  Baselinepointnumber
                   E=1060.000m   N=2060.000m   H=420.000m

Offset.         :  1.0000m

Point no.       :  1025
                   E=1005.961m   N=2048.409m   H=398.497      hr=1.115m

Deltas          :  dO=        4.3403m
                :  dL=        3.0907m
                :  dL-P2=    67.610m
                :  dH=       -1.5027m

Define Line and Offset
Offset          :  -1.000m
Line            :  70.711m
Elevation       :  401.000m

Line&Offset
Point No.       :  1026
Design          :  E=1100.000m   N=2100.000m   H=401.000
Staked          :  E=1100.051m   N=2099.989m   H=401.102      hr=1.115m
Differences     :  dE=0.051m     dN=0.011m     dH=0.102
```

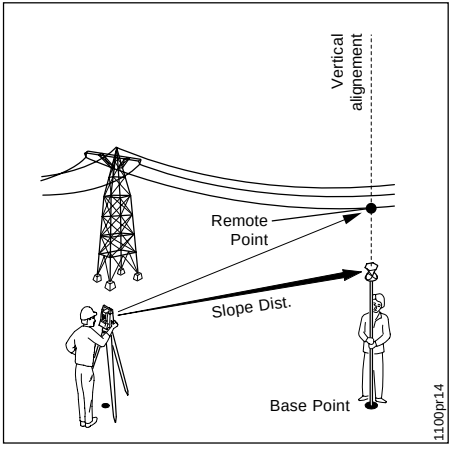
Typical log file entries in the "REFERENCE LINE" program.

Introduction

This manual describes the "Remote Height" program of the TPS1100 Professional series.

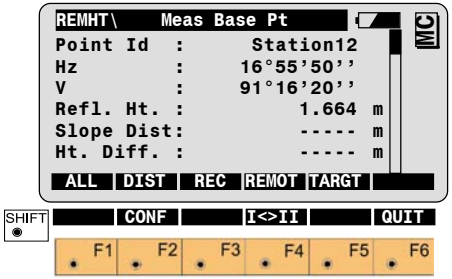
Remote Height is used to determine the elevation of inaccessible points, e.g. on cables or building facades. First, the distance to a base point situated vertically below (or above) the remote height point must be measured. Then you can aim to the remote height point.
The coordinates of the remote point are calculated from the distance measured to the base point and from the angles measured to the remote point.
To ensure correct results, the target and the reflector must be lined up vertically. In practice it is not generally possible to maintain an exactly-vertical line, and so you must decide what lateral deviation can be tolerated.

The horizontal distance to the inaccessible target must however coincide with the horizontal distance to the reflector.
When the instrument is aligned and the station coordinates have been set, the position coordinates of the remote height can be calculated and stored in the measurement job.



Measure Base Point

This dialog is used in accordance with the settings of the system function "Measure & Record" or according to the dialog shown below.



Point Id
The point number of the base point.

Hz
Horizontal direction from the remote point to the base point.

V
Vertical angle to the remote point.

Refl. Ht.
Reflector height used for the target point.

Slope Dist.
Slope distance from the instrument station to the base point.

Ht. Diff.
Height difference between the base point ground and the instrument ground.

F1 Simultaneously measure and record in the active measurement job. Proceed with the "REMOTE POINT" dialog.

F2 F3 Measure a distance. Record the measurement in the active measurement job and proceed with the "REMOTE POINT" dialog.

F2 F4 Measure the distance. Accept the measurement without recording. Proceed with the "REMOTE POINT" dialog.

F5 Enter the target data. (see User Manual)

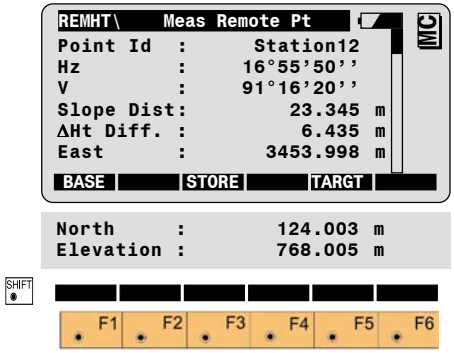
F4 Proceed with "REMOTE POINT" dialog.

SHIFT F2 Start the "Configuration Editor".

SHIFT F4 Change the theodolite face.

SHIFT F6 Exit the program.

Once the base point has been measured, this dialog shows the position of the point - above or below the base point - aimed with the telescope. The data are immediately updated while turning the instrument.



Point Id
The point number of the remote point.

Hz
Horizontal direction from the instrument to the remote point.

V
Vertical angle to the remote point.

Slope Dist.
Slope distance from the instrument station to the remote point. (calculated)

Δ Ht. Diff.
Height difference between the remote point and the base point ground.

East
Calculated Easting for the remote point.

North
Calculated Northing for the remote point.

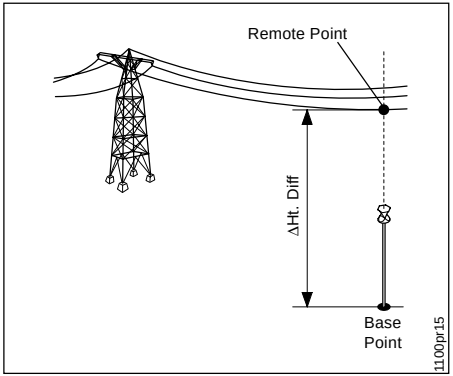
Elevation
Calculated Elevation for the remote point.

F1 Return to the "Measure Base Point" dialog.

F3 Record the measurement in the measurement job.

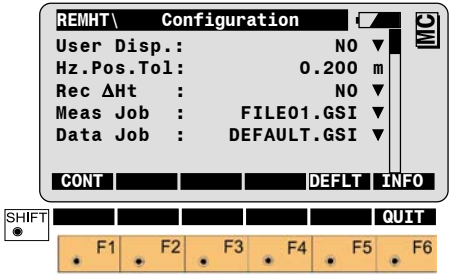
F5 Enter the target data. (see User Manual)

SHIFT F6 Exit the program.



Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "Measure Remote point" dialog.



The "Configuration Editor" sets parameters for further program operations:

User Disp
Set to **YES**, the display defined in the "MEAS" application will be used.
If set to **NO**, the "REMOTE HEIGHT" default display applies.

Hz.Pos.Tol
Horizontal distance tolerance that valid point measurements cannot exceed.

Rec ΔHt
NO The Height difference **ΔHt.diff** between remote and base point is not recorded.
Rec in WI37
ΔHt.diff is stored as record WI37 in the measurement job.

Meas Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

F1 Accept the current configuration and proceed to the dialog "MEASURE BASE PT".

F5 Reset configuration parameters to their default values.

F6 Displays date and version of the running application.

Introduction

This manual describes the "Hidden Point" program of the TPS1100 Professional series.

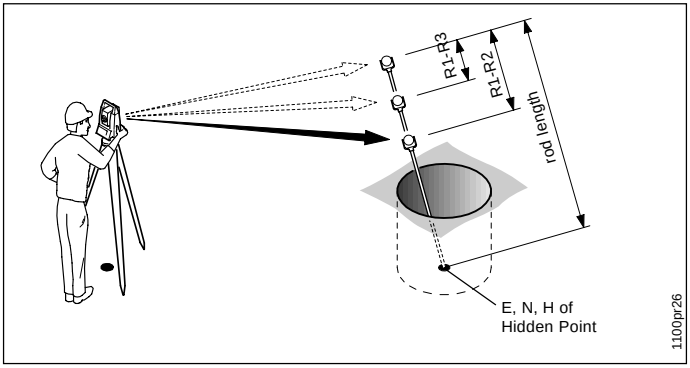
The program allows measurements to a point that is not directly visible, using a special hidden-point rod. The data for the hidden point are calculated from measurements to the prisms mounted on the rod with a known spacing and a known length of rod. The rod may be held at any angle, as long as it is stationary for all measurements.

"Measurements" are calculated as if the hidden point was observed directly. These "calculated measurements" can also be recorded.
The hidden-point rod can have either two or three reflectors. The rod you are using is defined in the "Configuration" of the program.

Here, you enter the length of the rod, spacing between reflectors, and the prism constant. *Refer to the following picture, which illustrates a hidden-point rod with three reflectors.*

If the hidden-point rod you are using has three reflectors, the program calculates coordinates for the hidden point from three measurement combinations:

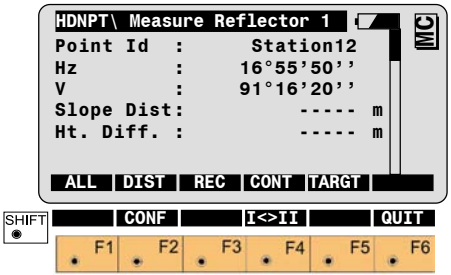
Reflector 1 + Reflector 2
Reflector 3 + Reflector 2
Reflector 1 + Reflector 3



The X, Y and Z coordinate values resulting from each of these measurement combinations are meaned to produce the XYZ coordinates of the hidden point.

In the case of motorized theodolites, you can configure the program so that it points the telescope at the third reflector automatically, after the first two reflectors have been measured.

The program will display the TPS 1100 "Measure & Record"dialog or the dialog shown below.
If the difference of the given and measured spacing between the prisms exceeds the "Meas. Tol. limit" a message is displayed.
You may accept the measurement or re-measure the prism.



F1 Simultaneously measure and record in the active file.
Proceed with the same dialog for the next prism. If the last point has already been measured, the program will proceed to the "RESULT" dialog.

F2 F3 Measure a distance. Record the measurement in the active file and proceed with the same dialog for the next prism. If the last prism has already been measured, the program will proceed to the "RESULT" dialog.

F2 F4 Measure the distance. Accept the measurement without recording. Proceed with the same dialog for the next prism. If the last prism has already been measured, the program will proceed to the "RESULT" dialog.

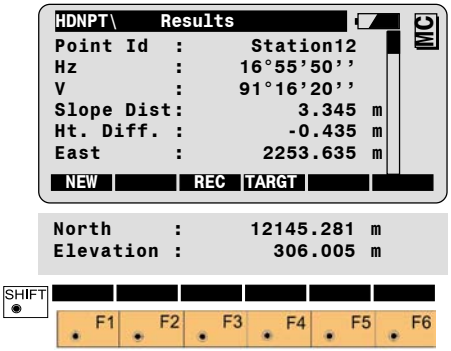
F5 Enter the target data. (see User Manual)

Note: When using the Hidden Point program, you must NOT change the target properties with the TARGT function, except to set the ppm for the measurements. The prisms on the hidden point rod MUST be defined in the CONFIGURATION of Hidden Point.

SHIFT F4 Change the theodolite face.

SHIFT F6 Press this key combination to quit the Hidden Point program at any time.

Once all reflectors have been measured, the program will display the results of the hidden-point calculation.
Using 3 reflectors the mean values of the “HIDDEN POINT“ are displayed.



Point Id
The Point number.

Hz
Horizontal direction to the hidden point.

V
Vertical angle to the hidden point.

Slope Dist.
Slope distance to the hidden point.

Ht. Diff
Height difference from instrument station to the hidden point.

East
Calculated Easting (E) for the hidden point.

North
Calculated Northing (N) for the hidden point.

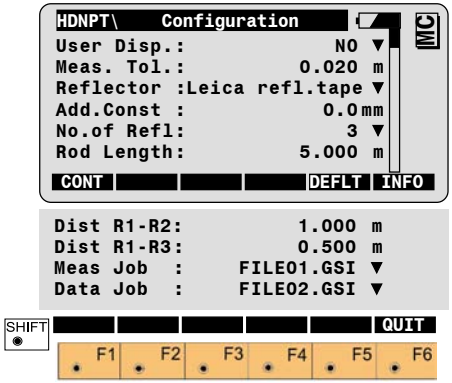
Elevation
Calculated Elevation for the hidden point.

F1 Take a new hidden-point measurement.

F3 Store the point calculation on the recording device.

F4 Enter target data. (see User Manual)

SHIFT F2 Start the "Configuration Editor" from the "MEASURE" dialog.



User Display

YES user defined display

NO the default display of the program "HIDDEN POINT".

Meas. Tol

Limit for the difference between the given and measured spacing of the reflectors. If the tolerance value is exceeded, the program will issue a warning.

In case of measurements with 3 prism the values is used as limit for the max. deviation of the 3 measurements.

Add. const.

Input of prism constant for the prisms of the rod. The prism constant set in the system is disregarded.

No. of Refl.

Number of the prisms on the rod you are using. Move the input cursor to this line, then toggle to either 2 or 3.

Auto pos.

When ON, the program will automatically point the telescope of a motorized theodolite at the third prism once the first two prisms have been measured. The exact pointing must be made manually.

Rod Length

Total length of hidden-point rod.

Dist. R1-R2

Spacing between the centers of reflector R1 and prism R2.

Dist. R1-R3

Spacing between the centers of prism R1 and prism R3. Enter only for rods with three prisms. Prism 3 must be situated between prism 1 and 2.

Refer to Figure on page 79, which illustrates a hidden point rod with three reflectors.

F1 Accept the current configuration and proceed to "MEASURE ROD"
Note that all parameters for the rod you are using must be defined before you can proceed. If any of the parameters have not been defined, the program will issue an error message to this effect. Press OK to clear the message, then make any necessary settings in the "CONFIGURATION".

F5 Set values to default. Default values are displayed.

F6 Displays date and version of the running application.

Example of Measurement data

Measurements to Point Ids 2 and 3 (the first two records) are the raw measurements. The measurement to Point Id 4 is the hidden point measurement - the measurement that could have been made if Point Id 4 was not behind an obstruction between it and the instrument station (with a Refl. Ht = 0.)

In this GSI8 example, the Recording Mask is the standard polar mask (Point Id, Horizontal Circle, Vertical Circle, Slope Distance and ppm / Offset. The actual data recorded will be determined by the Recording Mask in effect at the time the measurement and/or hidden point data are recorded.

```
110041+00000002 21.322+07018850 22.322+06455150 31..00+00003078
51..1.+0000+034
110042+00000003 21.322+10896450 22.322+06213050 31..00+00002910
```

Example: GSI8 Measurement data

Logfile

Hidden Point does not generate a logfile.

To Test / Prove the Hidden Point program
Setup and orient the instrument in an open area. Check the configuration to be sure the hidden point rod and prisms are properly defined. Position the tip of the hidden point rod on a mark that is directly visible from the instrument location.
Start the hidden point program and, making sure the hidden point rod does not move between measurements, measure the prisms on the hidden point rod.

Store the coordinates of the "hidden point" on the Memory Card. Start the Setting Out program, make sure the configuration allows for 3D positioning, then select the previously stored "hidden point" for setting out. Motorized instruments will drive directly to the point, which will then be behind the crosshairs of the telescope.

Manually turn non-motorized instruments until the ΔHz and ΔV both equal zero. The "hidden point" will be behind the crosshairs of the telescope.

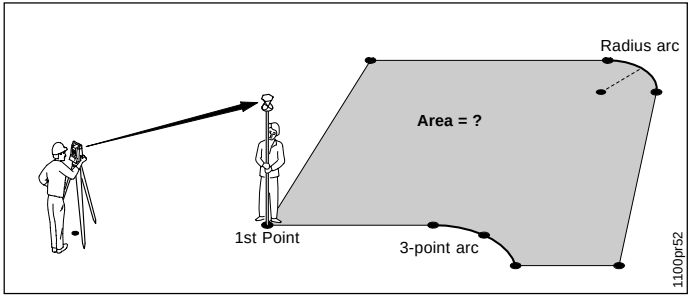
Uses for the Hidden Point program
The hidden point program may be used to obtain accurate three dimensional coordinates for a point that is currently blocked from direct measurement by an obstruction between the point and the instrument.

Typical uses are:
- Determination of flow line locations and elevations in manholes, without measuring from the rim of the manhole to the flow line and estimating corrections for non-verticality of the measuring tape and eccentricity from the measurement on the rim to the horizontal location of the flow line;
- Determination of recesses in building corners for detailed surveys, without estimating right angle offsets, with or without taping of the dimensions;
- Measurements behind overhangs, buttresses and columns for quantity determinations in underground construction or mining, without estimating right angle offsets, with or without taping of the dimensions;
- Measurements of industrial process piping or other equipment in close quarters;
- Detailed architectural surveys for remodeling or cultural preservation or restoration work;
- Any place where accurate measurements would require many more instrument setups in order to achieve line of sight from the instrument to the points being measured.

Introduction

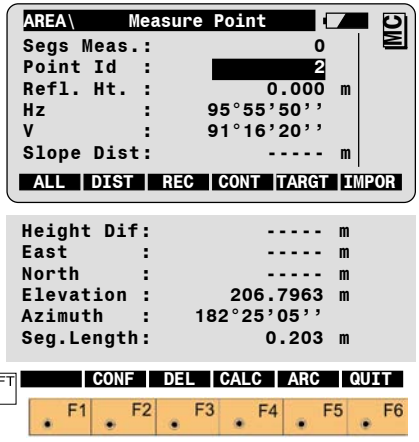
This manual describes the "Area" program of the TPS1100 Professional series.

An area can be defined by a series of straight lines and arcs. Arcs are defined by 3 radial points or 2 radial points and radius.



Measure Mode

Straight line



Segs Meas.
Counts the number of segments. With a new area the segment counter will be set to zero.

Seg. Len.
Length of the last straight line segment measured.

F1 Simultaneously measure and record data in the active measurement job.

F2 F3 Measure a distance and record data in the active measurement job.

F2 F4 Measure a distance without recording.

F5 Enter the target data. (*see User Manual*)

F6 Import target coordinates.

SHIFT F2 Start the "Configuration editor".

SHIFT F3 Deletes last completed segment. Resume at the start of a new segment.

SHIFT F4 Close the area polygon to the start point and calculates area and length of perimeter. The display of the results is shown in *chapter "Calculation".*

SHIFT F5 Select arc as the next segment.

SHIFT F6 Quit the Area program.

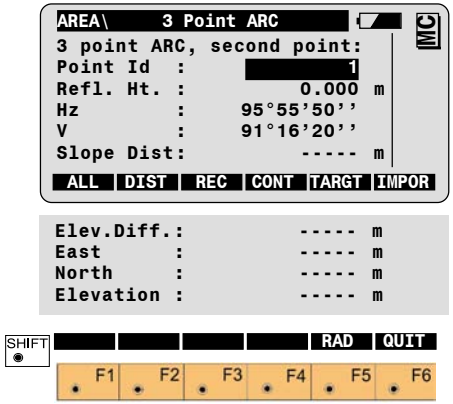
Arcs

During measurement, you can choose the ARC function to measure an arc defined by 3 radial points or 2 points and radius.
Select the wished ARC function after having measured the first point of arc.

Ensure the central angle of any arc is always smaller than 180° (200 gon).

- **Three Points**

Determine the second and third points of an arc sequentially. Completing the third point the program continues with Dialog "Measure point".



F1 Simultaneously measure and record data in the active measurement job.

F2 F3 Measure a distance and record data in the active measurement job.

F2 F4 Measure a distance without recording.

F5 Enter the target data.

F6 Import target coordinates.

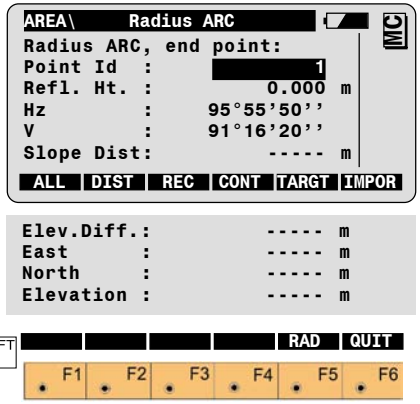
SHIFT F5 Select arc defined by 2 points and radius.

CODE Call up the CODE function.

SHIFT F6 Exit the program.

- **Radius Arc**

Determine the two points of an arc sequentially. After the end point the "Measure point" dialog prompts to input the radius.



F1 Simultaneously measure and record data of the end point of arc in the active measurement job.

F2 F3 Measure a distance and record data of the end point of arc in the active measurement job.

F2 F4 Measure a distance without recording.

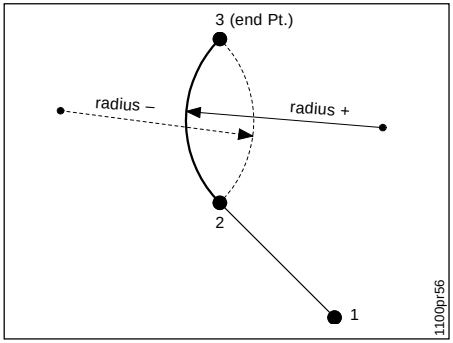
F5 Enter the target data. (see User Manual)

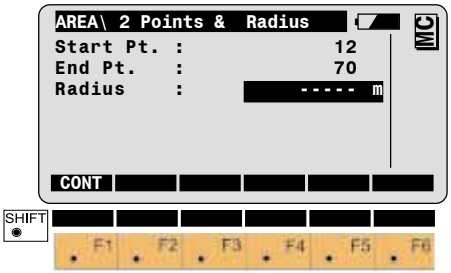
F6 Import target coordinates.

SHIFT F5 Press 3 Pt. to switch to the 3-Point Arc method.

SHIFT F6 Exit the program.

For arcs to the left enter the radius positive and for arcs to the right enter the radius negative.

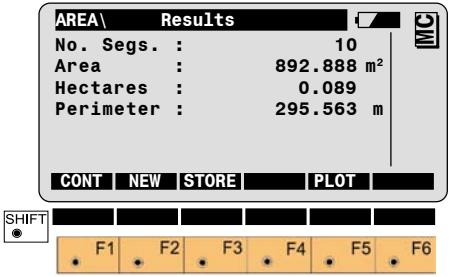




Radius
Enter the radius.

F1 Accept the input. Continue with dialog "MEASURE POINT".

Displays number of segments, computed area and length of perimeter.



No. Segs.
Number of segments used.

Area
Computed area in units of measure.

Hectares/Acres
Computed area in hectares or acres[1]. 1 acre = 43560 ft².

Perimeter
Length of perimeter of the current unit of measure.

[1] depending on the setting of the distance unit metre or feet.

F1 Continue with dialog "MEASURE POINT".

F2 Start a new area. Resets the segment counter to zero. Results of the last area computation will be erased.

F3 The following format will be used to record calculated area results:

WI 41: Code block identification (default = 36)
WI 42: Number of segments used.
WI 43: Area in the current measurement units, always with one decimal place.
WI 44: Length of perimeter in the current units of measure with one decimal place.

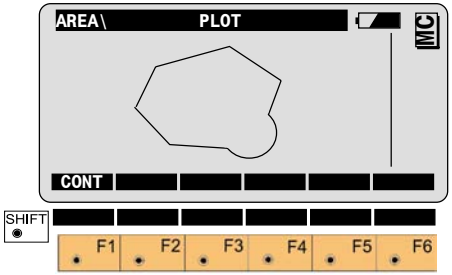
Code (default = 36)	no. of segments =4	area polygon 4500.3 m²	length polygon perimeter
▯ ▯▯ ▯			
WI 41	WI 42	WI 43	WI 44

F5 Generate a plot of the area.

SHIFT F6 Exit the program.

Plot

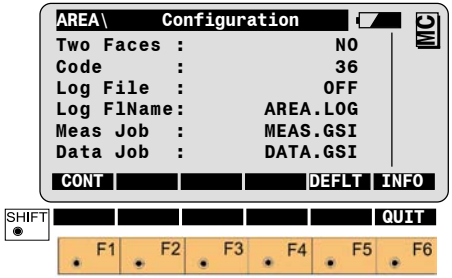
Shows a plot of the present area.



F1 Return to the dialog "RESULTS".

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the Configuration Editor from the "Measure Point" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces
YES for dual-face measurement,
NO for single-face.

Code
Enter the block identification code for recording the area results (max. eight alpha numeric characters)

Log File
Set to **ON**, the program will record measurement data in a log file in the format *described on the last page of this chapter.*

Log FlName
Enter the Log File Name.

Meas. Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

F1 Store the current configuration and proceed to the dialog "Measure Point".
Points can be added to the current area or a new area can be started.

F5 Set the values to default.

F6 Display date and version of the running application

SHIFT F6 Exit the program.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

If "Log File" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time.

Record
For each section of the area, start point and end point, horizontal distance and azimuth are stored.

For arcs with 2 points and radius the azimuth of arc, radius and length of arc are also stored.

For 3 point arcs the direction of arc, radius and length of arc are also stored.

```
Leica Geosystems  Program Area V 1.00
Instrument              : TCM1103, Serial  102999
Meas. file              : MYFILE.GSI
Program Start           : 20/04/1998 at 09:42

Segment Number          : 1
Start Point             : 1
End Point               : 2
H Distance              : 5.5555m
Azimuth                 : 140°11'17"

Segment Number          : 2
Start Point             : 2
End Point               : 4
Curve Right/Radius      : 4.9089m
ARC Length              : 2.326m

Segment Number          : 3
Start Point             : 4
Second Point            : 5
End Point               : 6
Curve Right/Radius      : 5.362m
ARC Length              : 2.254m

Number of Segments      : 3
Area                    : 9.8496m2
Hectares                : 0.0010
Perimeter               : 13.8396m
```

Typical log file entry in the "AREA" program

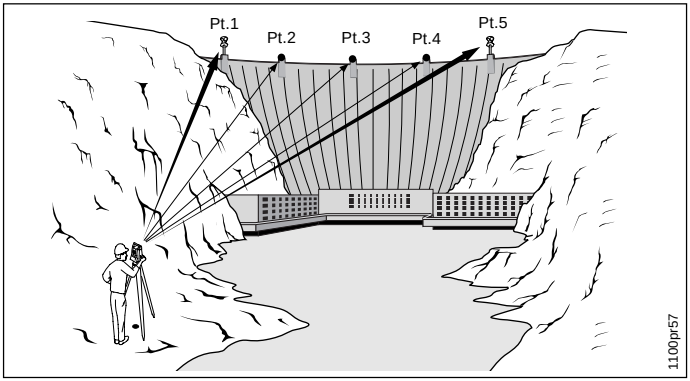
Introduction

This manual describes the "Sets of Angles" program for the TPS1100 Professional series instruments.

Sets of Angles is used to measure directions to targets for which coordinates are not necessarily known. Distance measurements are optional.

It provides field checking and analysis of measurements, while the instrument remains setup on the station.

The adequacy / accuracy of measurement data may be verified before leaving the observing station. With motorized instruments, rough pointing to each station is automatic, the operator need only refine the pointing before measuring. This eliminates observations to incorrect targets.



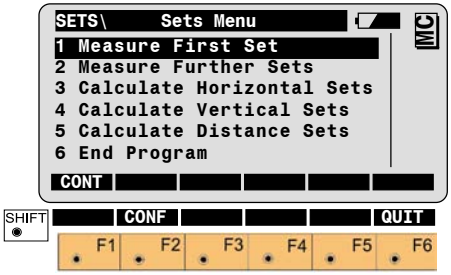
With Automatic Target Recognition, fine pointing and measurement can be automatic when the target is a reflector. The operator makes only the first observation to each station, then the rest of the measurements can be fully automated.
A minimum of two full sets must be observed, and all target points must be observed in Face I and Face II.
Sets of Angles has a "Learning Phase" during which it "learns" the positions and target Point Ids of the points you wish to measure.

"Learning" occurs automatically as you observe each target point in Face I. This information is then used to prompt you through the completion of your measurements at the station.

A maximum of 64 measurements per instrument station (in both faces) can be handled in one calculation. For instance, you may measure 16 sets to 4 target points, 8 sets to 8 target points, etc.

Sets menu

The target Point Ids and the sequence of measurement to the target points are stored in the program during the observation of the first half of the first set (in Face I.) This is the "Learning Phase." To complete the first set, and during the observation of the additional sets, you will be offered the target points in the sequence defined during the learning phase. If you are using a non-motorized instrument, the horizontal and vertical differences will be displayed, to guide you to the correct target point. Motorized instruments will automatically drive to the target point. TCA- and TCRA-instruments may make all measurements automatically, after the learning phase.

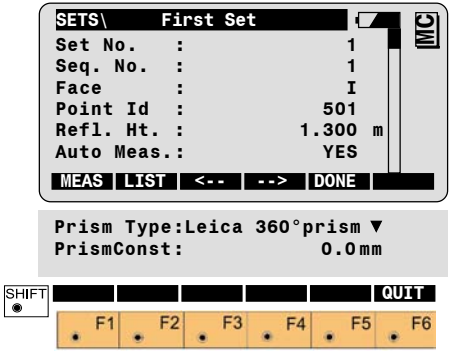


SHIFT F2 Start the "CONFIGURATION" Option, if available.

Measure Mode

- **Measure First Set**

This is the learning phase of the Sets of Angles program. Your inputs and measurements will be stored by the program to guide you through the balance of the measurement process.
You must measure to all desired target points in this set during the learning phase, and you may not add target points to the set after you leave the learning phase.



Set No.
Displays the number of the set currently being measured. Always "1" in the learning phase.

Seq. No.
Displays the sequential number of the point currently being measured.

Face
Displays the required instrument face for this measurement.

Point Id
Input the Point Id of the point currently being measured.

Refl. Ht.
(Optional, but necessary for the program to correctly calculate the elevation of the target point.) Input the Reflector Height of the point currently being measured.

Auto Meas.
Automatic Measurement option, available only with motorized instruments. Select **ON** or **OFF** as desired.

If **OFF**, motorized instruments must be manually pointed to this target point in further sets.

If **ON**, motorized instruments will automatically turn toward this target point in further sets.

If **ON** and the **target is a prism**, motorized instruments with ATR will automatically turn toward, fine point and measure to this target point.

Prism Type
(Optional, but necessary for the instrument to correctly measure the distance to the target point.) Select the type of prism at this target point.

PrismConst
Display only of the offset of the current Prism Type. Will be updated if the Prism Type is changed.

Press after all settings are correct and go to the Measurement Dialog.

(Optional) Press to create a list of up to ten target points. Subsequent measurements may then be made by selecting the target point from this list.

F3 (Not available until a list of target points has been defined.) Press to select the previous point on the list.

F4 (Not available until a list of target points has been defined.) Press to select the next point on the list.

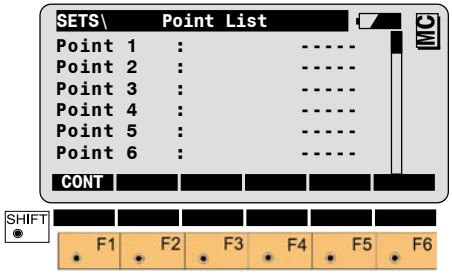
F5 Press when all target points have been measured in Face I. You will see a warning that you are leaving the Learning Phase.

Press **YES** to continue. The program returns to the Sets Menu with the focus on 2 Measure Further Sets.

Press **NO** if you pressed DONE in error. The program returns to this dialog.

SHIFT F6 Press to Quit Sets of Angles. This option is available on nearly every dialog within Sets of Angles.

F2 Press to view Point list.

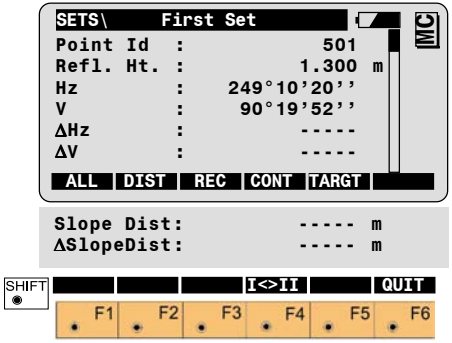


Point 1 - 10

Input up to ten Point Ids to enable selection from this list on the preceding dialog. You are not required to measure to every target point on this list.

F1 Press after all target Point Ids have been input.

Manually point the instrument at the target point. If the target is a prism and you are using a TCA- or TCRA-instrument with ATR turned on, you need point only "close" to the target. When you are "on target" select one of the measurement options:



Point Id
Displays the Point Id of the point currently being measured, as input on the previous dialog.

Refl. Ht.
Displays the Reflector Height of the point currently being measured, as input on the previous dialog.

Hz
Displays the current value of the Horizontal Circle.

V
Displays the current value of the Vertical Circle.

Δ Hz
Displays the difference between the current value of the Horizontal Circle and the first direction to the target point. Displays as dashes during the learning phase.

Δ V
Displays the difference between the current value of the Vertical Circle and the first direction to the target point. Displays as dashes during the learning phase.

Slope Dist
Displays the distance to the target point. Displays as dashes until a distance is measured manually.

Δ SlopeDist
Displays the difference between the current distance to the target point and the first distance to the target point. Displays as dashes during the learning phase.

Measure the distance to the target point, record the measurement results in the Meas Job and return to the previous dialog. Data will also be stored internally by Sets of Angles.

Measure the distance to the target point and remain at this dialog.

Record the measurement results in the Meas Job and return to the previous dialog. Data will also be stored internally by Sets of Angles.

Store the measurement results internally and return to the previous dialog. Data will not be stored in the Meas Job.

(May not be available) Check and/or set the reflector type, reflector height, ppms.

- **Measure Set**

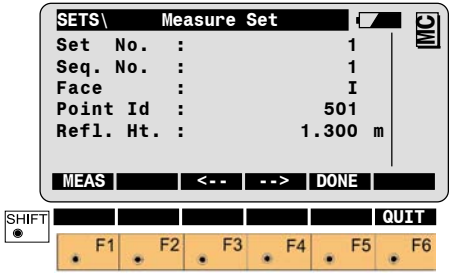
At the conclusion of the learning phase, select Measure Further Set. You will be prompted to make the measurements, in the sequence you selected in Configuration, to complete the first Set of measurements.

- Non-motorized instruments will display the Telescope Positioning dialog to help you find the target points in sequence.

- Motorized instruments will automatically turn to the target points in sequence. You must refine the pointing manually. After completing the first set, the program returns to the Sets Menu.

- With TCA- or TCRA-instruments and Auto. Meas. = **ON**, the first set will be completed automatically and the program returns to the Sets Menu.

You will use this dialog to measure all additional sets at this instrument station.



Set no.
Displays the number of the set currently being measured.

Seq. no.
Displays the sequential number of the point currently being measured.

Face
Displays the required instrument face for this measurement.

Point Id
Displays the Point Id of the point currently being measured.

Refl. Ht.
Displays the Reflector Height of the point currently being measured.

F1 Press to measure to the displayed target point in the displayed face.

F3 Press to measure to the previous target point in the displayed face. You may measure points out of sequence, but this may have undesirable effects in your post-processing software.

F4 Press to measure to the next target point in the displayed face. You may measure points out of sequence, but this may have undesirable effects in your post-processing software.

F5 Press when all target points have been measured in Face II or to abort measurement.

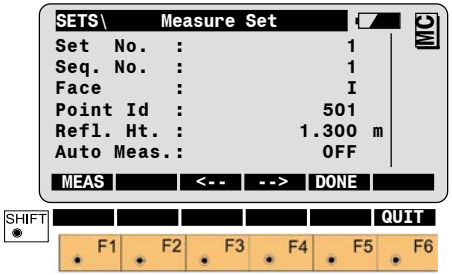
- **Measure Further Set**

After finishing the first set, select Measure Further Set again. You must repeat the above procedure to measure at least one more set. You may measure more than one additional set, up to the maximum number of pointings supported by Sets of Angles (64 Face I / Face II pointings to targets.)

If you have a motorized instrument, you will be able to specify the number of additional sets, and the instrument will turn to each target point in sequence until all the additional sets have been measured. TCA- and TCRA-instruments will automatically measure to all target points that have the Auto. Meas. parameter set to ON.

If you have a non-motorized instrument, you will select Measure Further Set after each set is completed, until all additional sets have been measured.

The Telescope Positioning dialog will help you find the target points in sequence.



Set no.
Displays the number of the set currently being measured.

Seq. no.
Displays the sequential number of the point currently being measured.

Point Id
Input the Point Id of the point currently being measured.

Refl. Ht.
(Optional, but necessary for the program to correctly calculate the elevation of the target point.) Input the Reflector Height of the point currently being measured.

Auto Meas.
Automatic Measurement option, available only with motorized instruments. Select ON or OFF as desired.

If **OFF**, motorized instruments must be manually pointed to this target point in further sets.

If **ON**, motorized instruments will automatically turn toward this target point in further sets.

If **ON** and the target is a prism, motorized instruments with ATR will automatically turn toward, fine point and measure to this target point.

Prism Type
(Optional, but necessary for the instrument to correctly measure the distance to the target point.) Select the type of prism at this target point.

PrismConst
Display only of the offset of the current Prism Type. Will be updated if the Prism Type is changed.

Press after all settings are correct and go to the Measurement Dialog.

(Optional) Press to create a list of up to ten target points. Subsequent measurements may then be made by selecting the target point from this list.

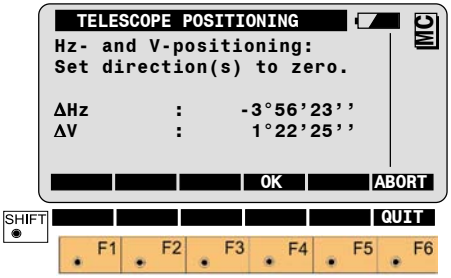
(Not available until a list of target points has been defined.) Press to select the previous point on the list.

(Not available until a list of target points has been defined.) Press to select the next point on the list.

Press when all target points have been measured in Face II or to abort measurement.

- **Telescope Positioning (non motorized instruments only)**

To help you locate the target points easily when you are using a non-motorized instrument, and to reduce the possibilities for errors in target point identification, Sets of Angles displays the differences between the current orientation of the telescope and the "learned" direction to the target point specified on the previous dialog.



Δ Hz
Displays the difference between the current value of the Horizontal Circle and the first direction to the target point. Manually turn the instrument until the value is zero, then the instrument will be oriented toward the target point.

Δ V
Displays the difference between the current value of the Vertical Circle and the first direction to the target point. Manually turn the instrument until the value is zero, then the instrument will be oriented toward the target point.

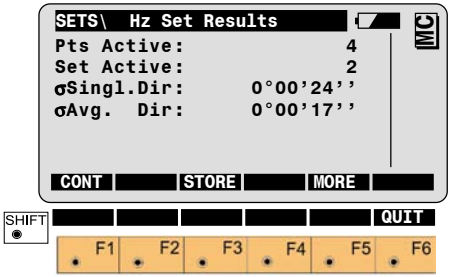
F4 Press when you are ready to measure to the target point. You will see the Measure Further sets measure dialog. This is not displayed until the telescope is within 0°27' (0.5 gon) of the target point.

F6 Press to abort and return to the previous dialog.

- **Calculate Horizontal and Vertical Sets**

The general display format is the same for horizontal directions, vertical directions and slope distances. The data displayed refer to the calculation function selected from the Sets Menu.
Standard deviations of a single direction in both faces (σSingl.Dir) and the standard deviation for an averaged direction from all sets (σAvg. Dir) are calculated.

Computations of standard deviations require that all targets and sets are observed in two faces. Exceptions may exist, in which case the standard deviation should be seen as an approximation to be used as a field control. The correct standard deviations a posteriori in this case can be calculated using the recorded data and a suitable computation method.



Pts. Active
Number of observed points used in the calculation.

Sets Active
Number of observed sets used in the calculation.

σSingl.Dir
Standard deviation of one observed horizontal or vertical direction, ok slope distance

σAvg. Dir
Standard deviation of an average direction ok slope distance from all sets.

F3 Results of sets of angles are recorded in the Meas Job. (*For details see dialog "FORMATS AND MORE INFORMATION"*)

F5 Show the results of individual measurements on the screen. (*For details see dialog "More Information"*).

F1 Returns to Set Menu.

SHIFT F6 Exit the program.

- **Example of Measure Job Data**

The following data are the result of running Sets of Angles to measure three sets to three target points (Point Ids 2, 3 and 5.) The horizontal, vertical and distance results were stored in the Meas. Job as well. The instrument was set to store data in GSI8 format using the long-time Leica Geosystems "standard" raw measurement data.

Record numbers 1 through 18 (110001 - 110018) are the raw measurement data. Records 19 through 39 (410019 - 410039) are the results data. The results data are explained below.

```
110001+00000002 21.322+20650070 22.322+06456000 31..08+00307660 51..1.+0000+000
110002+00000003 21.322+24530390 22.322+06215080 31..08+00290900 51..1.+0000+000
110003+00000005 21.322+29713310 22.322+07412400 31..08+00459730 51..1.+0000+000
110004+00000005 21.322+09713570 22.322+32587690 31..08+00459610 51..1.+0000+000
110005+00000003 21.322+04530500 22.322+33784700 31..08+00290800 51..1.+0000+000
110006+00000002 21.322+00650090 22.322+33543850 31..08+00307620 51..1.+0000+000
110007+00000002 21.322+20649620 22.322+06456000 31..08+00307670 51..1.+0000+000
110008+00000003 21.322+24529920 22.322+06215230 31..08+00290890 51..1.+0000+000
110009+00000005 21.322+29712870 22.322+07412590 31..08+00459740 51..1.+0000+000
110010+00000005 21.322+09713140 22.322+32587570 31..08+00459600 51..1.+0000+000
110011+00000003 21.322+04529930 22.322+33784680 31..08+00290830 51..1.+0000+000
110012+00000002 21.322+00649620 22.322+33543880 31..08+00307620 51..1.+0000+000
110013+00000002 21.322+20649680 22.322+06456170 31..08+00307660 51..1.+0000+000
110014+00000003 21.322+24529940 22.322+06215210 31..08+00290900 51..1.+0000+000
110015+00000005 21.322+29712900 22.322+07412560 31..08+00459740 51..1.+0000+000
110016+00000005 21.322+09713160 22.322+32587480 31..08+00459620 51..1.+0000+000
110017+00000003 21.322+04530200 22.322+33784770 31..08+00290800 51..1.+0000+000
110018+00000002 21.322+00649690 22.322+33543840 31..08+00307620 51..1.+0000+000
410019+HZ-RESLT 42....+00000003 43....+00000003 44....+00000038 45....+00000022
410020+HZ-MEAN0 42....+00000002 43....+00000000
410021+HZ-MEAN0 42....+00000003 43....+03880358
410022+HZ-MEAN0 42....+00000005 43....+09063360
410023+HZ-DIFF0 42....+00000002 43....+10000000 44....+20000000 45....+30000000
410024+HZ-DIFF0 42....+00000003 43....-10000034 44....+20000063 45....-30000029
410025+HZ-DIFF0 42....+00000005 43....+10000003 44....-20000020 45....+30000016
410026+V0-RESLT 42....+00000003 43....+00000003 44....+00000057 45....+00000033
410027+V0-MEAN0 42....+00000002 43....+06456103
410028+V0-MEAN0 42....+00000003 43....+06215224
410029+V0-MEAN0 42....+00000005 43....+07412466
410030+V0-DIFF0 42....+00000002 43....+10000022 44....+20000042 45....-30000064
410031+V0-DIFF0 42....+00000003 43....+10000029 44....-20000041 45....+30000011
410032+V0-DIFF0 42....+00000005 43....+10000102 44....-20000026 45....-30000076
410033+D0-RESLT 42....+00000003 43....+00000003 44....+00000004 45....+00000002
410034+D0-MEAN0 42....+00000002 43....+00307642
410035+D0-MEAN0 42....+00000003 43....+00290853
410036+D0-MEAN0 42....+00000005 43....+00459673
410037+D0-DIFF0 42....+00000002 43....+10000002 44....-20000003 45....+30000002
410038+D0-DIFF0 42....+00000003 43....+10000003 44....-20000007 45....+30000003
410039+D0-DIFF0 42....+00000005 43....+10000003 44....+20000003 45....-30000007
```

- **Formats and Data Recording**

The following formats are used to record results in the Meas Job.

Horizontal direction results:

WI 41 HZ-RESLT = Horizontal direction results
V0-RESLT = Vertical direction results
D0-RESLT = Slope distance results

WI 42 Number of target points observed

WI 43 Number of sets active in the computation

WI 44 Standard deviation of a single horizontal or vertical direction, or a slope distance

WI 45 Standard deviation of the mean horizontal or vertical direction, or slope distance

Horizontal Results	Number of target points =3	Number of sets =3	mR (standard deviation of a single direction) =3.8 cc	mM (standard deviation of the mean direction) =2.2 cc
410019+HZ-RESLT	42....+00000003	43....+00000003	44....+00000038	45....+00000022
WI 41	WI 42	WI 43	WI 44	WI 45

WI 41 HZ-MEAN0 = Mean horizontal direction
V0-MEAN0 = Mean vertical direction
D0-MEAN0 = Mean slope distance

WI 42 Target Point Id

WI 43 Mean value

Horizontal Mean	Target Point Id	Mean Horizontal Direction (First target point always =0)
410020+HZ-MEAN0	42....+00000002	43....+00000000
410021+HZ-MEAN0	42....+00000003	43....+03880358
410022+HZ-MEAN0	42....+00000005	43....+09063360
WI 41	WI 42	WI 43

WI 41 HZ-DIFF0 = Horizontal direction residual, per set
V0-DIFF0 = Vertical direction residual, per set
D0-DIFF0 = Slope distance residual, per set

WI 42 Target Point Id

WI 43 - 48 Residuals, per set

Residual (Mean Direction) per Set	Target Point Id	Set number and residual (Point Id 3, Set 1 = - 3.4 cc)	Set number and residual (Point Id 3, Set 2 = +6.3 cc)	Set number and residual (Point Id 3, Set 3 =- 2.9 cc)
410020+HZ-DIFF0	42....+00000002	43....+10000000	44....+20000000	45....+30000000
410020+HZ-DIFF0	42....+00000003	43....-10000034	44....+20000063	45....-30000029
410020+HZ-DIFF0	42....+00000005	43....+10000003	44....-20000020	45....+30000016
WI 41	WI 42	WI 43	WI 44	WI 45

Vertical direction results:

Vertical Results	Number of target points =3	Number of sets =3	mR (standard deviation of a single direction) = 5.7 cc	mM (standard deviation of the mean direction) = 3.3 cc
410019+V0-RESLT	42....+00000003	43....+00000003	44....+00000057	45....+00000033
WI 41	WI 42	WI 43	WI 44	WI 45

Vertical Mean	Target Point Id	Mean Vertical Direction
410020+V0-MEAN0	42....+00000002	43....+06456103
410020+V0-MEAN0	42....+00000003	43....+06215224
410020+V0-MEAN0	42....+00000005	43....+07412466
WI 41	WI 42	WI 43

Residual (Mean Direction) per Set	Target Point Id	Set number and residual (Point Id 3, Set 1= + 2.9 cc)	Set number and residual (Point Id 3, Set 2= - 4.1 cc)	Set number and residual (Point Id 3, Set 3= +1.1 cc)
410020+V0-DIFF0	42....+00000002	43....+10000022	44....+20000042	45....-30000064
410020+V0-DIFF0	42....+00000003	43....+10000029	44....- 20000041	45....+30000011
410020+V0-DIFF0	42....+00000005	43....+10000102	44....- 20000026	45....-30000076
WI 41	WI 42	WI 43	WI 44	WI 45

Slope distance results

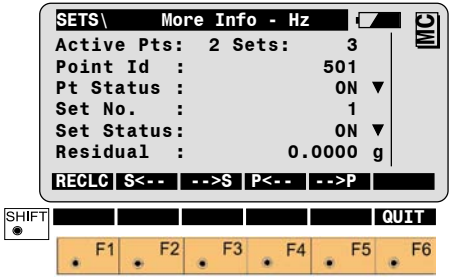
Distance Results	Number of target points =3	Number of sets =3	mR (standard deviation of a single direction) = 0.4 mm	mM (standard deviation of the mean direction) = 0.2 mm
410019+D0-RESLT	42....+00000003	43....+00000003	44....+00000004	45....+00000002
WI 41	WI 42	WI 43	WI 44	WI 45

Distance Mean	Target Point Id	Mean Distance
410020+D0-MEAN0	42....+00000002	43....+00307642
410020+D0-MEAN0	42....+00000003	43....+00290853
410020+D0-MEAN0	42....+00000005	43....+00459673
WI 41	WI 42	WI 43

Residual (Mean Distance) per Set	Target Point Id	Set number and residual (Point Id 3, Set 1= +0.3 mm)	Set number and residual (Point Id 3, Set 2= - 0.7 mm)	Set number and residual (Point Id 3, Set 3= +0.3 mm)
410020+D0-DIFF0	42....+00000002	43....+10000002	44....- 20000003	45....+30000002
410020+D0-DIFF0	42....+00000003	43....+10000003	44....- 20000007	45....+30000003
410020+D0-DIFF0	42....+00000005	43....+10000003	44....+20000003	45....-30000007
WI 41	WI 42	WI 43	WI 44	WI 45

- **More Information**

Further information is given relating to the differences of the measurements. Single points or full sets can be deactivated prior to calculation.



Active Pts
Number of points used in the calculation.

Sets
Number of sets used in the calculation.

Point no.
Target point.

Pnt. Status
Point used for computation (**ON/OFF**).

Set no.
Present displayed set.

Set Status
Point used for computation (**ON/OFF**).

Residual
Difference in horizontal direction, vertical direction or slope distance, using the direction of the active set and the averaged direction of all sets. For the vertical directions, the residual is used to compute the standard deviations.

F1 Re-calculate the results and return to the dialog showing the results.

F2 Display previous set.

F3 Display the next set.

F4 Display the previous point.

F5 Display the next point.

SHIFT F6 Exit the program.

A typical example of a Hz - measurement is shown in the following list:
The example shows a survey with 3 sets and 4 targets with directions in ° ' ".
The calculations are carried out according to the following table.

$$mR = \sqrt{\frac{\Sigma v^2}{(N-1)\,(s-1)}} = \sqrt{\frac{23''}{(4-1)\,(3-1)}} = \pm 2''$$

$$mM = \frac{mR}{\sqrt{s}} = \frac{2''}{\sqrt{3}} = \pm 1''$$

PtNr	Face I	Face II	Average face I+II (a)	Reduced average of set (b)	Average (d)	r= d - b	v= r+q	v²
1	0°00'20"	180°00'17"	0°00'19"	0°00'00"	0°00'00"	0	+1	1
2	24°43'34"	204°43'31"	24°43'33"	24°43'14"	24°43'10"	-4	-3	9
3	84°47'15"	264°47'11"	84°47'13"	84°46'54"	84°46'53"	-1	0	0
4	306°41'52"	126°41'42"	306°41'47"	306°41'28"	306°41'28"	0	+1	1
					q= -(Σ r)/N q =	-(5")/4 +1	Σ v=-1	
1	45°00'13"	225°00'16"	45°00'15"	0°00'00"		0	0	0
2	69°43'24"	249°43'23"	69°43'24"	24°43'09"		+1	+1	1
3	129°47'06"	249°47'08"	129°47'07"-9"	84°46'52"		+1	+1	1
4	351°41'45"	171°41'44"	351°41'45"	306°41'30"		-2	-2	4
					q= -(Σ r)/N q =	-(0)/4 0	Σ v=0	
1	90°00'19"	270°00'19"	90°00'19"	0°00'00"		0	-1	1
2	114°43'28"	294°43'26"	114°43'27"	24°43'08"		+2	+1	1
3	174°47'10"	354°47'15"	174°47'13"	84°46'54"		-1	-2	4
4	36°41'47"	216°41'45"	36°41'46"	306°41'27"		+1	0	0
					q= -(Σ r)/N q =	-(2)/4 -1	Σ v=-2	
							Σ v² =	23

A typical example of a V - measurement is shown in the following list:
The example shows a survey with 3 sets and 4 targets and directions in ° ' ".
The calculations are carried out according to the following table. The same method is used for slope distances.

$$mR = \sqrt{\frac{\Sigma v^2}{N*s-1}} = \sqrt{\frac{34''}{4*3-1}} = \pm 2''$$

$$mM = \frac{mR}{\sqrt{s}} = \frac{2''}{\sqrt{3}} = \pm 1''$$

Pt-Nr	Face I	Face II	Average face I+II (a)	Average (d)	v = d-a	v²
1	87°13'58"	272°46'24"	87°13'47"	87°13'46"	-1	1
2	88°42'12"	271°18'18"	88°41'57"	88°41'55"	-2	4
3	89°44'22"	270°16'00"	89°44'11"	89°44'11"	0	0
4	91°06'47"	268°53'38"	91°06'34"	91°06'33"	-1	1
1	87°14'01"	272°46'22"	87°14'49"		-3	9
2	88°42'09"	271°18'20"	88°41'54"		+1	1
3	89°44'27"	270°16'00"	89°44'13"		-2	4
4	91°06'47"	268°53'40"	91°06'33"		0	0
1	87°14'01"	272°46'34"	87°13'43"		+3	9
2	88°42'09"	271°18'20"	88°41'54"		+1	1
3	89°44'23"	270°16'04"	89°44'09"		+2	4
4	91°06'49"	268°53'42"	91°06'33"		0	0
					Σ V= -2	
					Σ v²=	**34**

Used formulae and designations

a = In both faces observed and averaged direction.
b = In both faces averaged and reduced direction of a set
d = Final averaged direction from all sets.
r = Difference between a final direction averaged from all sets and a single direction of a set.
q = Average of the differences (r).
v = Residuals.
s = Number of sets
N = Number of targets.

r = d - b
v = r + q for horizontal directions
v = d - a for vertical directions

Average of the differences for horizontal directions.

$$q = \frac{\Sigma r}{N}$$

Standard deviation of one horizontal direction observed in two faces.

$$mR = \sqrt{\frac{\Sigma v^2}{(N-1)\,(s-1)}}$$

Standard deviation of one vertical direction observed in two faces.

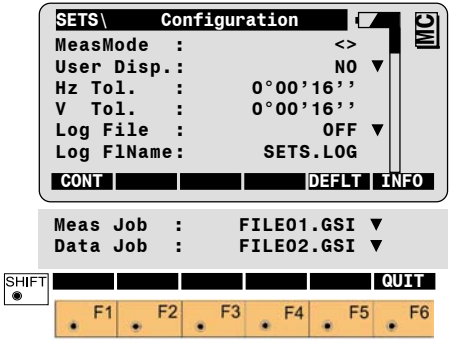
$$mR = \sqrt{\frac{\Sigma v^2}{N*s-1}}$$

Standard deviation of an averaged direction from all sets.

$$q = \frac{mR}{\sqrt{s}}$$

Configuration Editor

Start the "Configuration Editor" from the "SETS MENU" dialog.



The "Configuration Editor" sets parameters for further program operations:

Meas Method

> < All targets have to be observed for face II in **opposite** order to the observations in face I.

> > All targets have to be observed in face II using the **same** sequence as for the observations in face I.

◊ Each target has to be observed in face II immediately after its measurement for face I has been completed.

User Displ
Set to **YES**, the display defined in the "MEAS" application will be used.
NO uses the "SETS OF ANGLES" default display.

Hz Tol.
Input the tolerance for Hz-directions. This defines the limit for the difference between the actual direction and the direction observed within the first half set. A change in the horizontal circle orientation is always accounted for, after observing the first target within a new set. If the tolerance is exceeded, a warning is given.

V Tol.
Input the tolerance for vertical directions. This defines the limit for the difference in the vertical directions between the actual observations and the directions observed within the first half set. If the tolerance is exceeded, a warning is given.

Log File
ON, records measurements in a Log-File.
The format is described in *chapter "Log File" (see next page)*.

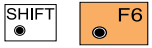
Log FlName
Enter the Log File Name.

Meas Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

Displays date and version.

Set default values. Default values are displayed in dialog "CONFIGURATION".



Exit the program

Store the current configuration and proceed to the dialog "SETS MENU".

If "LOG FILE" is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the program used, information about the instrument, the name of the data file as well as date and time the program was started.

Data
The average horizontal and vertical angles of all sets, the standard deviation for one measurement and the standard deviation of an angle averaged from all sets, are stored in the Log-File.

The following data are the result of running Sets of Angles to measure three sets to three target points and computing the horizontal, vertical and distance results (the same data as in the Meas Job shown previously.)

```
Leica Geosystems  Program Sets of Angles V 1.00
Instrument    :
Meas. File    : FILE01.GSI
Program Start : 29/04/1998 at 11:04

Station       : 1
                E=          100.00000m     N=       100.00000m
                H=          400.00000m     hi=        0.00000m

Horizontal set results:
3 Sets measured with 3 points each.

Standard deviation of any measurement                :        0.00038g
Standard deviation of mean from all measurements     :        0.00022g
1.  Point Id : 2
                mean direction  :                0.00000g
                Refl. Ht.       :                0.00000m
                Prism Type      :          Leica refl.tape
                Prism Constant  :                0.03440m
2.  Point Id : 3
                mean direction  :               38.80359g
                Refl. Ht.       :                0.00000m
                Prism Type      :          Leica refl.tape
                Prism Constant  :                0.03440m
3.  Point Id : 5
                mean direction  :               90.63361g
                Refl. Ht.       :                0.00000m
                Prism Type      :          Leica refl.tape
                Prism Constant  :                0.03440m
```

continues next page

```
Results of single sets:

1.  Point Id : 2
              Set  1  :  Residual  :        0.00000g
                         average   :        0.00000g
              Set  2  :  Residual  :        0.00000g
                         average   :        0.00000g
              Set  3  :  Residual  :        0.00000g
                         average   :        0.00000g
2.  Point Id : 3
              Set  1  :  Residual  :       -0.00034g
                         average   :       38.80393g
              Set  2  :  Residual  :        0.00064g
                         average   :       38.80295g
              Set  3  :  Residual  :       -0.00029g
                         average   :       38.80388g
3.  Point Id : 5
              Set  1  :  Residual  :        0.00003g
                         average   :       90.63357g
              Set  2  :  Residual  :       -0.00020g
                         average   :       90.63381g
              Set  3  :  Residual  :        0.00017g
                         average   :       90.63344g

Vertical set results:
3 Sets measured with 3 points each.

Standard deviation of any measurement                :        0.00057g
Standard deviation of mean from all measurements     :        0.00033g
```

continues next page

```
1.  Point Id : 2
              mean direction  :          64.56104g
              Refl. Ht.       :           0.00000m
              Prism Type      :        Leica refl.tape
              Prism Constant  :           0.03440m
2.  Point Id : 3
              mean direction  :          62.15225g
              Refl. Ht.       :           0.00000m
              Prism Type      :        Leica refl.tape
              Prism Constant  :           0.03440m
3.  Point Id : 5
              mean direction  :          74.12466g
              Refl. Ht.       :           0.00000m
              Prism Type      :        Leica refl.tape
              Prism Constant  :           0.03440m

Results of single sets:

1.  Point Id : 2
              Set  1  :  Residual :           0.00022g
                         average  :          64.56081g
              Set  2  :  Residual :           0.00042g
                         average  :          64.56061g
              Set  3  :  Residual :          -0.00064g
                         average  :          64.56168g

2.  Point Id : 3
              Set  1  :  Residual :           0.00030g
                         average  :          62.15195g
```

continues next page

```
                Set  2  :  Residual  :        -0.00041g
                           average   :        62.15266g
                Set  3  :  Residual  :         0.00011g
                           average   :        62.15214g
3.  Point Id : 5
                Set  1  :  Residual  :         0.00103g
                           average   :        74.12364g
                Set  2  :  Residual  :        -0.00026g
                           average   :        74.12493g
                Set  3  :  Residual  :        -0.00076g
                           average   :        74.12543g

Distance set results:
3 Sets measured with 3 points each.

Standard deviation of any measurement                :      0.00004m
Standard deviation of mean from all measurements     :      0.00002m

1.  Point Id : 2
                mean distance  :              3.07642m
                Refl. Ht.      :              0.00000m
                Prism Type     :          Leica refl.tape
                Prism Constant :              0.03440m
2.  Point Id : 3
                mean distance  :              2.90853m
                Refl. Ht.      :              0.00000m
                Prism Type     :          Leica refl.tape
                Prism Constant :              0.03440m
3.  Point Id : 5
```

continues next page

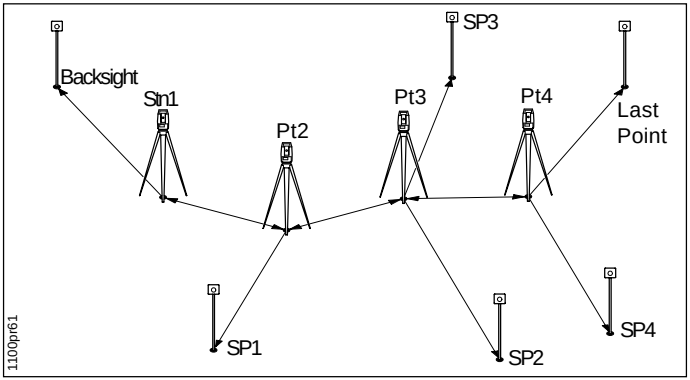
```
                mean distance :          4.59673m
                Refl. Ht.     :          0.00000m
                Prism Type    :      Leica refl.tape
                Prism Constant :         0.03440m

Results of single sets:

1.  Point Id : 2
                Set  1  :  Residual  :       0.00000m
                           average   :       3.07640m
                Set  2  :  Residual  :      -0.00003m
                           average   :       3.07645m
                Set  3  :  Residual  :       0.00000m
                           average   :       3.07640m
2.  Point Id : 3
                Set  1  :  Residual  :       0.00003m
                           average   :       2.90850m
                Set  2  :  Residual  :      -0.00007m
                           average   :       2.90860m
                Set  3  :  Residual  :       0.00003m
                           average   :       2.90850m
3.  Point Id : 5
                Set  1  :  Residual  :       0.00003m
                           average   :       4.59670m
                Set  2  :  Residual  :       0.00003m
                           average   :       4.59670m
                Set  3  :  Residual  :      -0.00007m
                           average   :       4.59680m
```

Introduction

This manual describes the "Traverse" program of the TPS1100 Professional Series instruments.

Using data about direction and distance, the program continuously computes the coordinates of the station (in the example shown above, the instrument "moves" from one station to the next, previously measured point) and aligns the horizontal circle.

For a point whose coordinates are known, the deviation from the coordinates determined by measurement can be computed and displayed.



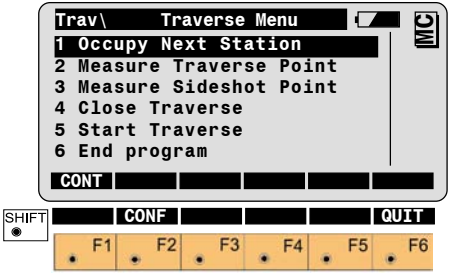
There is no adjustment of these differences in coordinates and direction. Subsequently, however, the measurements stored on the PCMCIA can be processed with the assistance of an appropriate software program.

Individual stations can be calculated as "sideshots" (SP). The coordinates and directions of these points are also determined in the course of this program.

If the program is terminated (e.g. to record a detail point), the values remain stored. The measurement procedure can be resumed after calling up the program again.

Traverse Menu

In this display, the individual functions of the program can be called. After a function has been performed, the user returns to this display.



Occupy Station
Select to occupy a station previously measured in this traverse.

Traverse Point
Select to measure to the next traverse station.

Sideshot Point
Select to measure to a sideshot point.

Close Traverse
Select to compute the misclosure data for the current traverse.

New Traverse
Select to discard any retained information and start a new traverse.

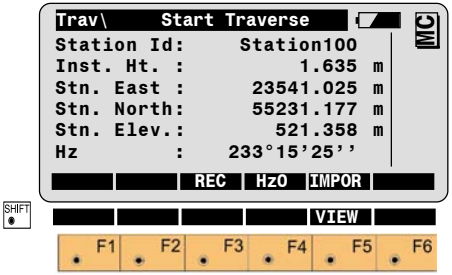
End Program
Select to end the traverse program. Data for the current traverse will be retained in memory for use if the program is restarted later.

F1 Press to accept the currently highlighted selection.

SHIFT + F2 Start the "CONFIGURATION".

SHIFT + F6 Press this key combination to quit the Traverse program at any time.

Any data of a previous traverse in the memory will be erased at the start of a new traverse. To avoid unintentional erasing, a confirmation must be made.
The first dialog requests the entry of the station point number, height of instrument, station coordinates and the setting of a specified Hz-angle.



Station Id
Input the Point Id of the first occupied station in the traverse.

Inst. Ht.
(Optional, but necessary to correctly compute elevations.) Input the height of the instrument tilting axis above the occupied station.

Stn.East
Input the Easting, or X ordinate, of the occupied station. The station coordinates may be imported using the IMPOR hotkey.

Stn.North
Input the Northing, or Y ordinate, of the occupied station.

Stn.Elev
(Optional, but necessary to compute elevations.) Input the Elevation, or Z ordinate, of the occupied station.

Hz
The current horizontal circle value.

F3 Records manually entered station data on the active recording device. The program proceeds to the "Measure Mode" dialog.

F4 Set horizontal-circle direction. For further information, please refer to chapter "Measure & Record" of "System" - user manual.

F5 Import station coordinates. For further information, please refer to chapter "Setup" of "System" - user manual.

SHIFT F5 Press this key combination to import and view the stored coordinates of a point.

- **Select method of orientation**

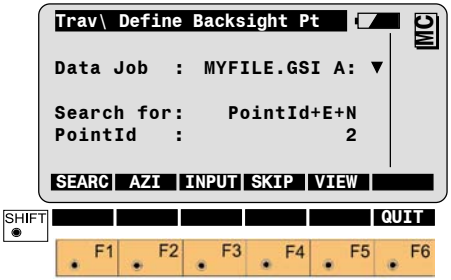
Three different methods orientation are available

1. Confirm the orientation already set in the system.[1] No measurements are performed (SYS).

2. Calculation of an azimuth from coordinates to one tie point. A following measurement to the tie point orients the Hz-circle (INPUT). *(See "Calculation Azimuth".*

3. Manual input of the azimuth to one tie point. A measurement to the tie point is required (AZI). *(See "Enter Backsight Azimuth")*

[1] If the orientation was previously determined with the "ORIENTATION" program, for example.



Data Job
Filename and location of the Job containing point coordinates to be recalled.

Search for
Describes what will be searched for in the Data Job.

Point Id
Input the Point Id to search for.

F1 Search coordinates in the Data Job. Continue with the "Measure Backsight Point" dialog.

F2 Select the "Measure Backsight Point" dialog and enter the azimuth.

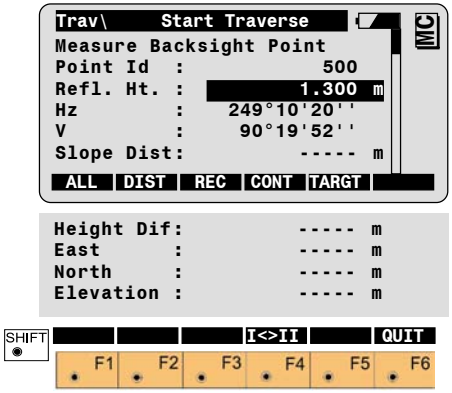
F3 Manual entry of coordinates for the tie point. The standard input dialog of the TPS 1100 is used. Continue with the "Measure Backsight Point" dialog.

F4 Confirms the present orientation. Continues with the dialog "TRAVERSE MENU".

F5 Search and view coordinates in the Data Job.

- **Calculate Azimuth**

This dialog corresponds to the TPS1100 Professional series "MEASURE" dialog.
On completion of a measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.



F1 Simultaneously measure and record data in the Meas Job.

F2 F3 Measure a distance[1] and record data in the Meas Job.

F2 F4 Measure a distance without recording in the Meas Job.

F4 Proceed to the dialog "TRAVERSE MENU".

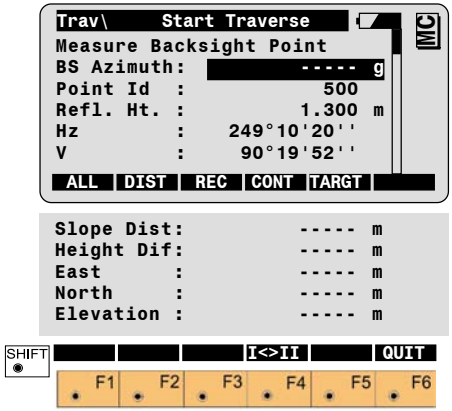
F5 Enter target data. (see User Manual)

SHIFT F4 Change the theodolite face.

[1] Distance measurement is optional.

- **Enter Backsight Azimuth**

This dialog corresponds to the TPS 1100 Professional series "MEASURE" dialog with the additional entry of the backsight azimuth.
On completion of the first measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.



BS Azimuth
Enter the backsight azimuth for the orientation.

F1 Simultaneously measure and record data in the Meas Job.

F2 F3 Measure a distance[1] and record data in the Meas Job.

F2 F4 Measure a distance without recording in the Meas Job.

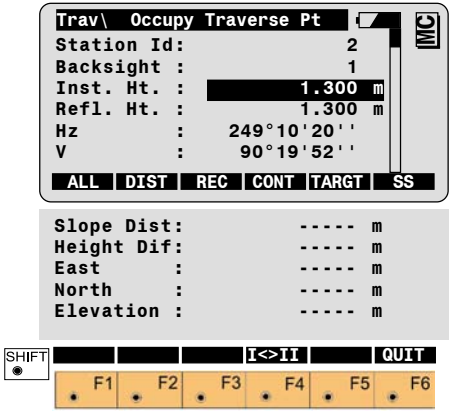
F5 Enter target data. (see User Manual)

SHIFT F4 Change the theodolite face.

[1] Distance measurement is optional.

The instrument is set up on previously measured traverse point. A measurement (distance measurement is optional) is made to the last traverse point.

This dialog corresponds to the TPS1100 Professional series "MEASURE" dialog. After the function has been performed, the station coordinates and orientation are set in the instrument.



Station Id
Station identifier

Backsight
Backsight identifier

F1 Simultaneously measure and record data in the Meas Job.

F2 F3 Measure a distance[1] and record data in the Meas Job.

F2 F4 Measure a distance without recording in the Meas Job.

F4 Proceed to the dialog "TRAVERSE MENU".

F5 Enter target data. (see User Manual)

F6 Toggles to select the last measured sideshot, or the last measured traverse point, as the new station.[2]

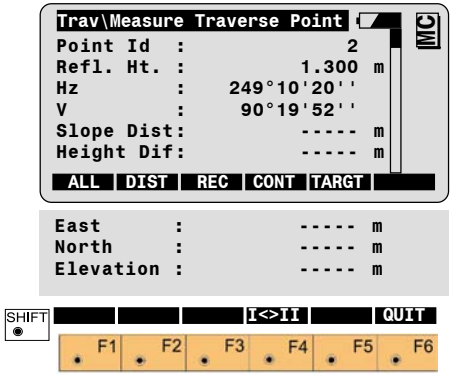
SHIFT F4 Change the theodolite face.

[1] Distance measurement is optional.

[2] Only active if a sideshot point was measured.

Only one Traverse Point may be measured to (distance required) from any given Occupy Station. As many Sideshot Points as desired may be measured (distance required).

This corresponds to the TPS1100 Professional series "MEASURE" dialog. After the measurement, the program continues either with "MULTIPLE MEAS" or with the "TRAVERSE MENU" according to the settings in the configuration.



F1 Simultaneously measure and record data in the Meas Job.

F2 F3 Measure a distance and record data in the Meas Job.

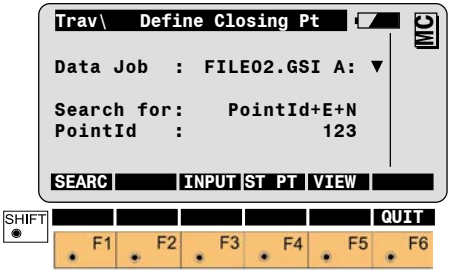
F2 F4 Measure a distance without recording in the Meas Job.

F4 Proceed to the dialog "TRAVERSE MENU".

F5 Enter target data. (see User Manual)

SHIFT F4 Change the theodolite face.

The program requires a closing point for comparison with the last traverse point measured. The default point number is the starting point of the traverse.

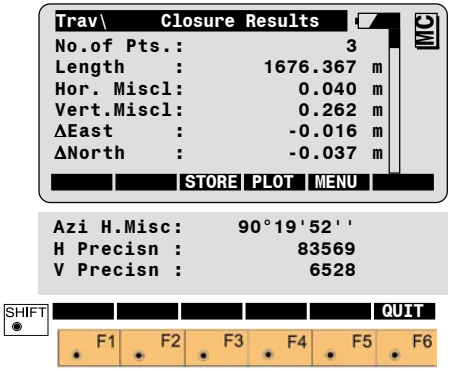


F1 Seach coordinates in the Data Job.

F3 Enter coordinates using the standard input dialog.

F4 Confirms the coordinates of the starting point.

F5 Search and view coordinates in the database.



No. of Pts.
Number of traverse points

Length
Length of traverse

Hor. Miscl.
Horizontal misclosure

Vert.Miscl.
Vertical misclosure

Δ East
Misclosure in easting (X)

Δ North
Misclosure in northing (Y)

Azi H.Misc
Azimuth of horizontal misclosure

H Precisn
Position precision

$$= \frac{\text{traverse length}}{\text{horizontal misclosure}}$$

V Precisn
Vertical precision

$$= \frac{\text{traverse length}}{\text{vertical misclosure}}$$

F3 The results of the traverse are recorded in the Meas Job.

F4 Plot of the traverse.

F5 Continue with the "Traverse Menu".

Examples

Codeblocks with results of the traverse closure:

WI 41: Code 38
WI 42: Number of traverse points.
WI 43: Length of traverse (sum of legs).
WI 44: Azimuth of misclosure

```
   410010+00000038  42....+0000005  43....+01013515
```

WI 41 Code 39
WI 42 Horizontal Misclosure
WI 43: Misclosure easting
WI 44: Misclosure northing
WI 45: Misclosure in height

```
410011+00000039 42...+0000123 43...+00000045 44...+00000114
45...+00000087
```

WI 41 Code 40
WI 42 Position precision (traverse length / Horizontal misclosure)
WI 43: Vertical precision (height difference / Horizontal misclosure)

```
410012+00000040   42....+0008239   43....+00011650
```

Measurement block with the traverse Station Coordinates of station points

WI 11: Point number
WI 25: ΔHz (correction of orientation)
WI 84: E_0 easting coordinate
WI 85: N_0 northing coordinate
WI 86: Height
WI 88: Instrument height

```
110015+00123456   25.143+14611200   84..40+00001215
85..40-00003153   86..40+00403285    88..10+00001555
```

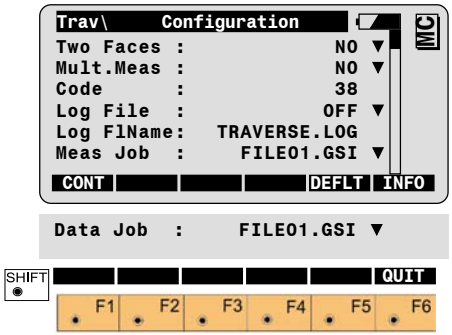
Plot

Generates a plot of the traverse.

F1 Return to the dialog "CLOSURE RESULTS".

Configuration Editor

Start the "Configuration Editor" from the "traverse menu" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces
YES for dual-face measurement
NO for single-face.

Mult.Meas
YES to allow multiple measurements,
NO for single measurement.

Code
Input the code number used when recording results in the Meas Job (max. 8 characters).

Log File
Set to ON, the program will record measurement data in the Log File according to the format described on *chapter Log File.*

Log FlName
Enter the Log File Name.

F1 Accept the displayed parameters and return to the "TRAVERSE MENU".

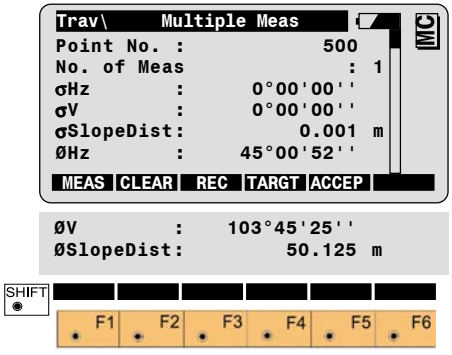
F5 Set all values to default. Default values are shown in dialog.

F6 Display the Traverse Information dialog.

Dual-face Measurement

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

The measurement to a point can be repeated as often as desired to achieve a higher accuracy or reliability. The mean value of the measurements and the respective standard deviation is displayed.



Point no.
The target point number.

No. of Meas
Counter of the measurements.

σ Hz
Standard deviation of the horizontal direction for a single measurement.

σ V
Standard deviation of the vertical angle for a single measurement.

σ Slope Dist
Standard deviation of the slope distance for a single measurement.

Ø Hz
Mean value of the Hz-measurements.

Ø V
Mean value of the V-measurements.

ØSlope Dist
Mean value of the slope distances.

F1 Further measurements.

F2 Delete all measurements of the current point and start again.

F3 Record the mean value of the measurements on the active recording device. Return to the "TRAVERSE MENU" dialog.

F4 Enter target data. (see User Manual)

F5 Accept the mean values and return to the "TRAVERSE MENU".

If "LOG FILE" is set to ON, the measurements and the results are stored in the LOG FILE specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header
The header line will contain the name of this program, information about the instrument, the name of the data file and date and time.

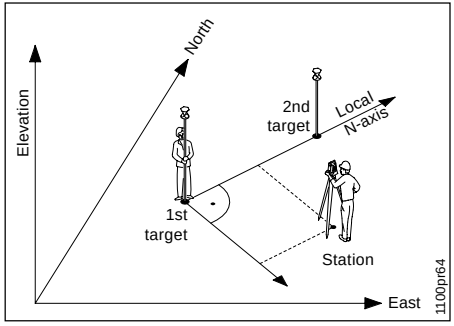
Record
Computed coordinates of traverse points are continously stored. The option Close traverse in the "TRAVERSE MENU" displays and stores at any time the coordinate - differences of traverse points of which the coordinates are known.

```
Leica Geosystems  Program Traverse V 1.00
Instrument        :   TCA1103, Serial 102999
Meas. File        :   MYFILE.GSI
Program Start     :   20/04/1998 at 10:25

Backsight         :   500
Station           :   Pt.1
                      E= -0.679m     N= 9.545m      H= 400.062m    hi= 1.530m

Station           :   Pt.2
                      E=-13.462m     N=10.528m      H= 400.170m    hi= 1.650m

Station           :   Pt.3
                      E=26.513m      N=16.821m      H= 401.260m    hi= 1.610m

Last Trav.Pt.     :   501
                      E= -77.949m    N= 25.037m     H= 399.923m

Closing Pt.       :   501
                      E= -78.016m    N= 24.996m     H= 400.181m

No. of Pts.       :   4
Length            :   82.788m
Hor. miscl.       :   0.047m
Vert. miscl.      :   0.268m
DEasting          :   -0.017m
DNorthing         :   -0.031m
Azi H.miscl       :   226°51'25"
H Precision       :   2036
V Precision       :   2356
```

Typical log file entry in the "TRAVERSE"

Introduction

This manual describes the "Local Resection" program of the TPS1100 Professional Series.



Two points are measured from any instrument station. The first point measured forms the centre of a local coordinate system (N=0; E=0; H=0). The second point measured determines the direction of the positive N - axis.

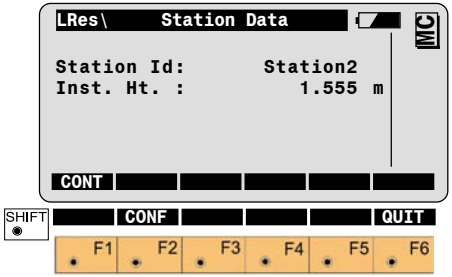
The program can be used to deduce the three-dimensional local coordinates for the instrument station and the orientation of the horizontal circle from measurements to 2 target points. To compute the position coordinates, at least 4 elements (2 distances and 2 directions) are necessary.

For simultaneous determination of the local station elevation, height of instrumentand height of reflector must already have been input.

The program allows measurement in single or dual-face mode.

Station Data

Enter station point number and height of the instrument.

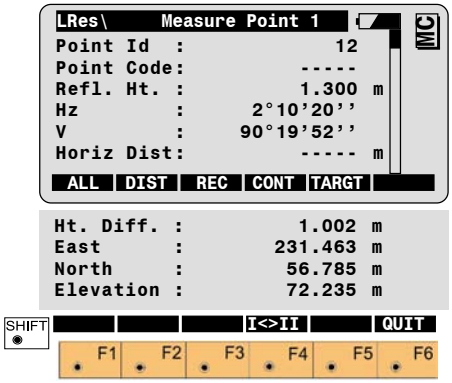


F1 Proceed to the dialog "MEASURE POINT 1".

SHIFT F2 Start the "CONFIGURATION"

SHIFT F6 Quit program.

This dialog is similar to the TPS1100's basic "MEASURE MODE" dialog. Once the measurement to the first and to the second point is taken, the program will proceed to the dialog "RESULTS".


LRes\ Measure Point 1
Point Id : 12
Point Code: -----
Refl. Ht. : 1.300 m
Hz : 2°10'20''
V : 90°19'52''
Horiz Dist: ----- m
ALL DIST REC CONT TARGT
Ht. Diff. : 1.002 m
East : 231.463 m
North : 56.785 m
Elevation : 72.235 m
SHIFT I<>II QUIT
F1 F2 F3 F4 F5 F6

F1 Simultaneously measure and record data in the active measurement job.

F2 Measure a distance.

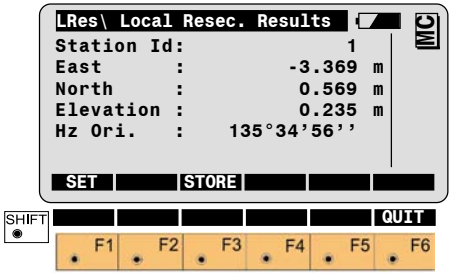
F3 Record the measurement in the active measurement job.

F4 Accept the measurement.

F5 Enter target data. (see User Manual)

SHIFT F4 Change the theodolite face.

In this dialog the calculated station coordinates are shown with orientation.



Station Id
Station point number

East
Calculated E (local) for the station

North
Calculated N (local) for the station

Elevation
Calculated Elevation (local) for the station

Hz. Ori
Angular correction needed to orient the instrument

F1 Set orientation and station coordinates on the instrument. Note that this key will end the program.

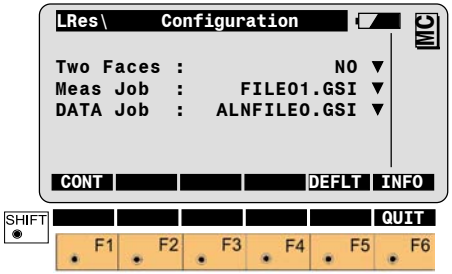
F3 Record the following results in the measurement job:

WI 11 Station Point Number
WI 25 Orientation correction
WI 84 Station Easting
WI 85 Station Northing
WI 86 Station Elevation
WI 87 Last reflector height used
WI 88 Instrument Height

SHIFT F6 Exit the program.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

SHIFT F2 Start the "Configuration Editor" from the "STATION DATA" dialog.



The "Configuration Editor" sets parameters for further program operations:

Two Faces
YES for dual-face measurement,
NO for single-face.

Meas. Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

Store the current configuration and proceed to the dialog "STATION DATA".

Set the value to the default.

Displays date and version of the running application.

In the dual-face mode, the program will prompt for measurements in both faces. When both measurements are taken, the program will check the difference between the two. If the difference in angle is within **27' (0.5 gon)** and the difference of two measured distances is within **0.5 m (1.64 ft)**, the observations will be averaged. These tolerances are used to avoid errors in target identification. If exceeded an error message will be displayed.

Introduction

This manual describes the "COGO" program of the TPS1100 Professional Series.
The following provides a general overview of the individual COGO functions.

The "**Inverse**" routine computes the direction and distance between two points.

The "**Traverse**" routine computes a new coordinate point given a direction and distance from a known point (Polar stakeout).

The "**Intersections**" routine computes:
- Bearing-Bearing intersections,
- Bearing-Distance intersections,
- Distance-Distance intersections or
- Intersection by Points

The function "**Offsets**" consists of the following subfunctions:
- "Distance point straight line"
  Calculates the difference in length/ abscissa and the lateral deviation/ ordinate with reference to a basis line emanating from a known point.
- "Orthogonal point calculation"
  A new point can be calculated which emanates from a basis line using the difference in length/ abscissa and the lateral deviation/ ordinate.

The "**Point Arc**" routine computes a radius point given any three points.

The point coordinates can either:
- be determined by measurement,
- entered manually using a keyboard or
- read from the memory card.

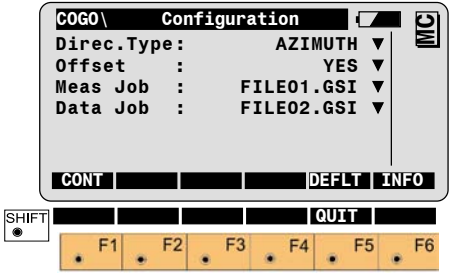
Data, both measured and read from the memory card, can be mixed. This means, however, that station coordinates and orientation have to be correctly set.

Directions and distances can be entered manually, called up or freshly determined. The values can then be amended by means of multiplication, division, addition and subtraction.

The program "Stakeout" can be called up directly from the individual result dialog boxes (if available) in order to set out the points immediately.
The program "Stakeout" assumes that the instrument is set and oriented to a known point.

Depending on the configuration that is loaded onto your TPS1100 instrument, you may not see some or all of the options referred to below. See your Leica Geosystems dealer for more information about the configuration of your instrument.

Start the "Configurations Editor" from the "**COGO MENU**" dialog.



The "Configuration Editor" sets parameters for further program operations:

Direc. Type Bearing
Azimuth

Offset
YES entering a parallel displacement is possible
NO entering a parallel displacement is not possible

Meas Job
Selection of the measurement job for recording measurements.

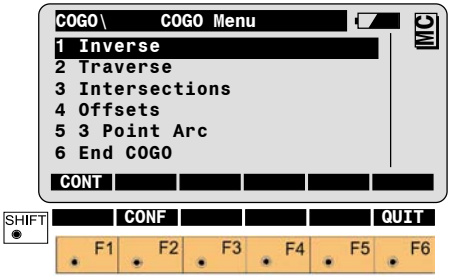
Data Job
Selection of the data job containing the fix point coordinates (control data).

F1 Accept displayed values and proceed to the dialog "COGO MENU".

F5 Set all values to default. The values are shown in the dialog above.

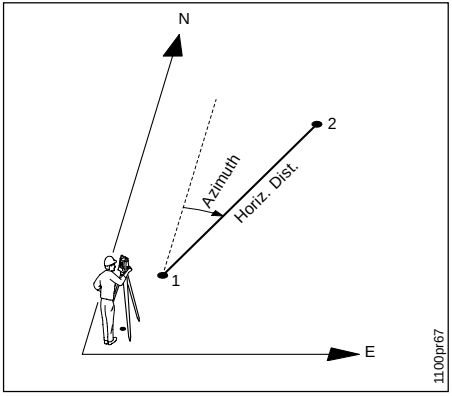
F6 Displays date and version.

SHIFT F6 Exit the program.



SHIFT F2 Call up the "Configuration-Editor".

Computes distance and direction between two points.

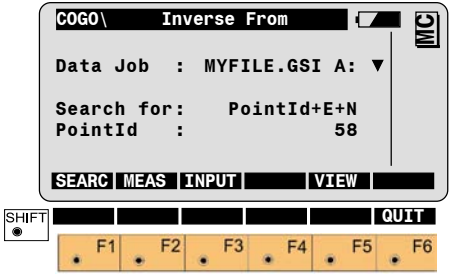


Search
- Direction (magnetic bearing or azimuth)
- Horizontal distance

Given
- point 1 (E, N)
- point 2 (E, N)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

1 Call up the function Inverse in the "**COGO MENU**" dialog.



F1 Search for the coordinates of the first (second) point in the datajob.

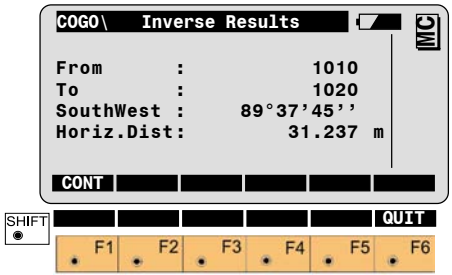
F2 Measuring the first (second) point of the straight line.

F3 Manual entering of the first (second) point of the straight line.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

The following dialog box shows the result of the polar calculation from both the given points:



From
Display of point number of the first point

To
Display of point number of the second point

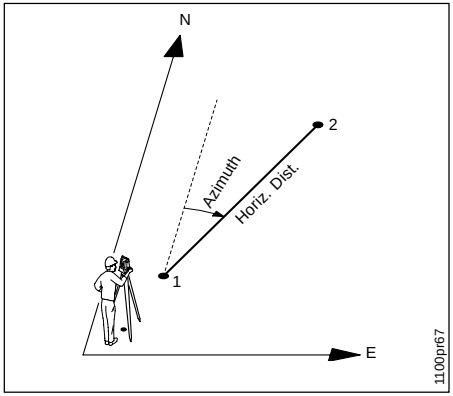
SouthWest
Display of magnetic bearing.
If "**Azimuth**" is selected in the configuration during "**Direc. Type**:", then the azimuth will be displayed between both the points.

Horiz.Dist.
Display of horizontal distance between the points

F1 Return to "COGO Menu".

SHIFT F6 Exit the program.

Computes a new point given a direction and distance from a known point.

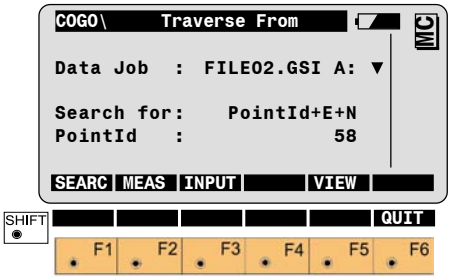


Search
- coordinates of point 2 (E, N)

Given
- point 1 (E, N),
- Direction (magnetic bearing or azimuth),
- Horizontal distance.

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 can be determined by measurement.

2 Call up the function "Traverse" from the "**COGO MENU**".



F1 Search for coordinates of the first point in the data job.
Continue to *„Defining direction by magnetic bearing“ or „Defining direction by azimuth“*.

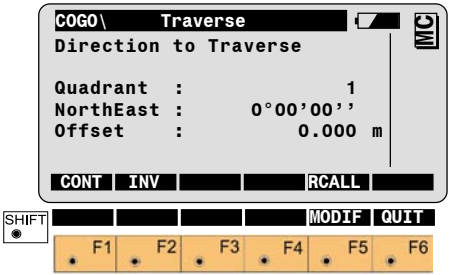
F2 Measuring the first point.

F3 Manual entering of the first point.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

If "**Bearing**" is selected in the configuration for "**Direc. Type:**", then the following dialog box appears:



Quadrant

Enter quadrant:
1 = NorthEast
2 = SouthEast
3 = SouthWest
4 = NorthWest

Northeast
Enter magnetic bearing

Offset
Enter parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset**:"
Left = negative parallel offset
Right = positive parallel offset

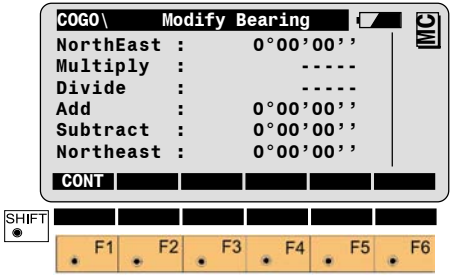
F1 Accept displayed values and proceed with dialog "Distance to Traverse".

F2 Determining the direction by means of the function "Polar calculation"(*refer to chapter "Inverse"*).

F5 INPUT Enter quadrant, magnetic bearing
RCALL Call up of a direction which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction see under existing dialog box "MODIFY BEARING"

SHIFT F6 Exit the program.



NorthEast
Display of entered magnetic bearings

Multiply
Entering multiplication factor

Divide
Entering division factor

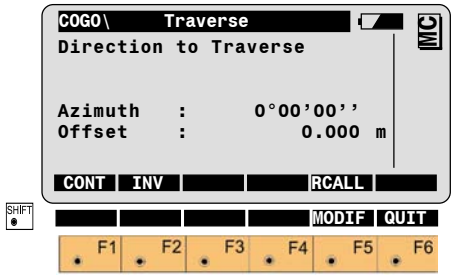
Add
Entering angle for a correction to the right

Subtract
Entering angle for a correction to the left

NorthEast
Display of corrected magnetic bearings

F1 Accept displayed values and proceed with *dialog "Distance to Traverse"*.

If "**Azimuth**" is selected in the configuration for "**Direc. Type:**", then the following dialog box appears:



Azimuth
Entering Azimuth

Offset
Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset

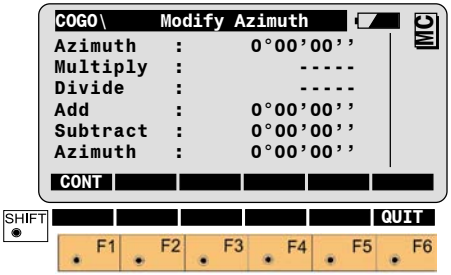
F1 Accept displayed values and proceed with *dialog "Distance to Traverse"*.

F2 Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "INVERSE").*

F5 INPUT Entering Azimuth
RCALL Call up of a direction which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(refer to dialog "Modify Azimuth ")*

SHIFT F6 Exit the program.



Azimuth
Display of corrected Azimuth

F1 Accept displayed values and proceed to *dialog "Distance to Traverse"* .

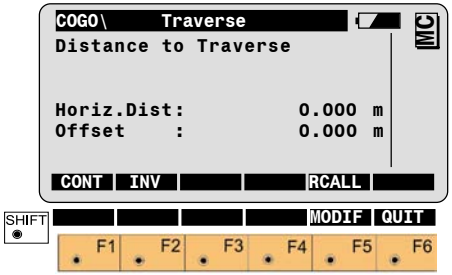
Azimuth
Display of entered Azimuth

Multiply
Entering multiplication factor

Divide
Entering division factor

Add
Entering angle for a correction to the right

Subtract
Entering angle for a correction to the left



Horiz.Dist
Entering horizontal distance

Offset
Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset:**"
Left = negative parallel offset
Right = positive parallel offset

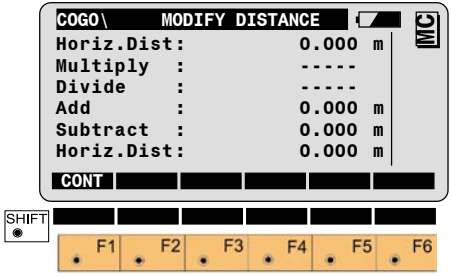
F1 Accept displayed values and proceed to *dialog "Traverse results".*

F2 Determining the distance by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT Entering horizontal distance
RCALL Call up of a distance which has been previously stored using the function "Polar calculation".

SHIFT F5 Changing the distance *(refer to dialog "Modify Distance").*

SHIFT F6 Exit the program.



Horiz.Dist.
Display of entered horizontal distance

Multiply
Entering multiplication factor

Divide
Entering division factor

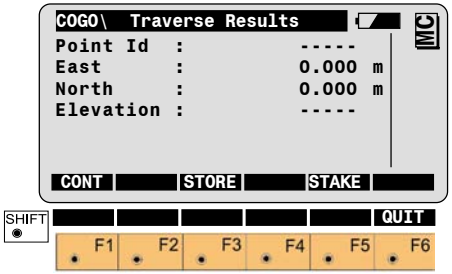
Add
Entering distance for a positive correction

Subtract
Entering distance for a negative correction

Horiz.Dist.
Display of corrected horizontal distance

Accept displayed values and proceed to *dialog "TRAVERSE RESULTS".*

The following dialog box shows the result of the traverse:



Point Id
Entering point number of the point to be accepted

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

F1 Return to "**COGO MENU**".

F3 The following results have been stored in the active measurement data file:

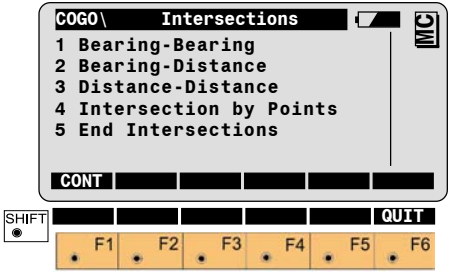
WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

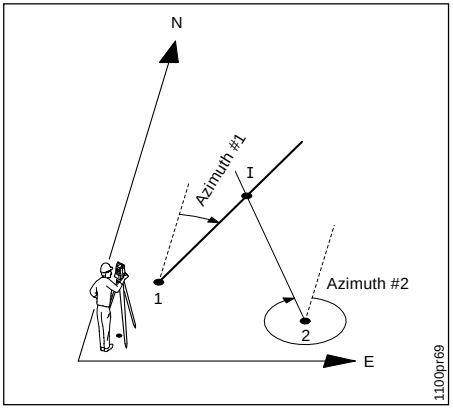
If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".
The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.

3 Call up the function"Intersections" from the "**COGO MENU**".



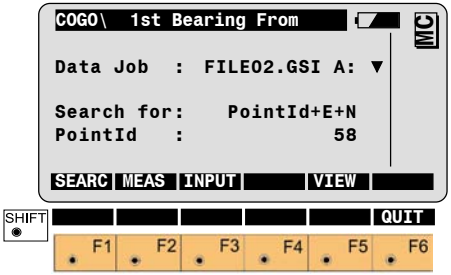


Search
- Coordinates of intersection (E, N)

Given
- point 1 (E, N), direction (magnetic bearing or azimuth)
- point 2 (E, N), direction (magnetic bearing or azimuth)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

1 Call up the function "Bearing-Bearing" from the menu "Intersections".



F1 Search for the coordinates of the first (second) point in the datajob.

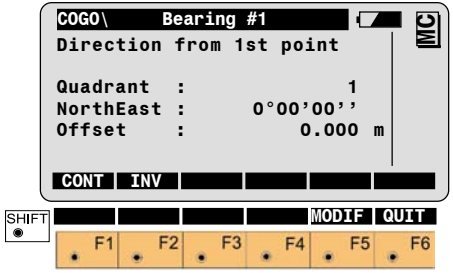
F2 Measuring the first (second) point of the straight line.

F3 Manual entering of the first (second) point of the straight line.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

If "**Bearing**" is selected in the configuration for "**Direc. Type:**", then the following dialog box appears:



Quadrant
Enter quadrant (First or second straight lines)
1 = Northeast
2 = Southeast
3 = Southwest
4 = Northwest

NorthEast
Enter magnetic bearing (First or second straight lines)
If "**Azimuth**" is selected in the configuration during "**Direc.Type:**", then the azimuth of the first straight line (or the second straight line) can be entered.

Offset
Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset**:"
Left = negative parallel offset
Right = positive parallel offset

F1 Accept displayed values.

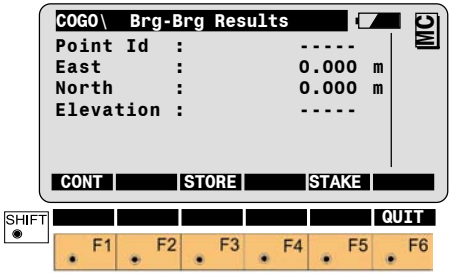
F2 Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT
Enter bearing, mangnetic bearing resp. azimuth (if "**Azimuth**" is selected in the configuration during "**Direc. Type:**"
RCALL
Call up of a direction which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(as dialog box "Modify Bearing", "Modify Azimuth")*

SHIFT F6 Exit the program.

The following dialog box shows the result of the bearing-bearing intersection:



Point Id
Entering point number of the bearing-bearing

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

F1 Return to "INTERSECTIONS".

F3 The following results have been stored in the active measurement data file:

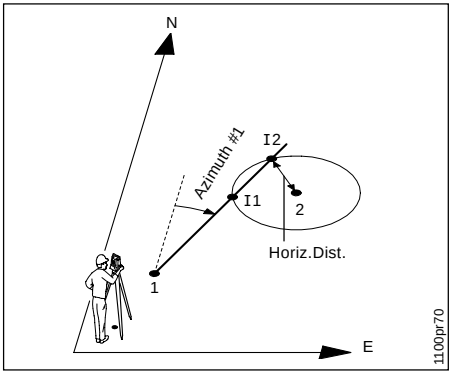
WI 11 Station Point Number
WI 81 Easting coordinate
WI 82 Northing coordinate
WI 83 Elevation (optional)

If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".

The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.



Search

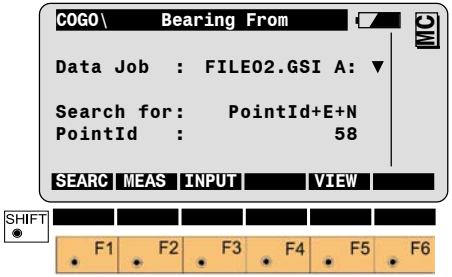
- Bearing-bearing coordinates S1 and S2 (E, N)

Given

- point 1 (E, N), direction (magnetic bearing or azimuth)
- point 2 (E, N), radius

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 (and/or 2) can be determined by measurement.

2 Call up the function "Bearing-Distance" from the menu "**INTERSECTIONS**".



F1 Search for the coordinates of the first point (or circle centre point) in the datajob.

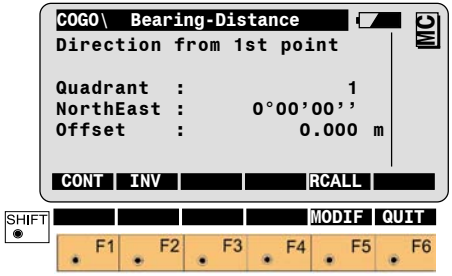
F2 Measuring the first point (or circle centre point).

F3 Manual entering of the first point (or circle centre point).

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

If "**Bearing**" is selected in the configuration for "**Direc. Type:**", then the following dialog box appears:



Quadrant
Enter quadrant:
1 = Northeast
2 = Southeast
3 = Southwest
4 = Northwest

NorthEast
Enter magnetic bearing
If "**Azimuth**" is selected in the configuration during "**Direc. Type:**", then the azimuth of the straight line can be entered.

Offset
Entering parallel displacement.
Only active if "**YES**" is entered in the configuration during "**Offset**:"
Left = negative parallel offset
Right = positive parallel offset

F1 Accept displayed values.

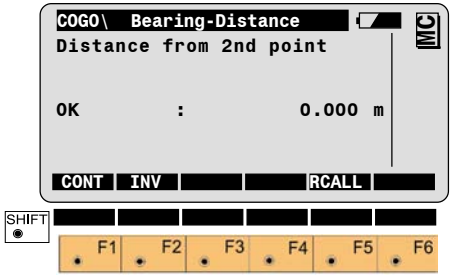
F2 Determining the direction by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT Enter bearing, mangnetic bearing resp. azimuth (if "**Azimuth**" is selected in the configuration for "**Direc. Type:**"
RCALL Call up of a direction which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(as dialog box "Modify Bearing", resp. "Modify Azimuth")*

SHIFT F6 Exit the program.

Enter distance from second point:



Horiz.Dist.
Entering radius

F1 Accept displayed values.

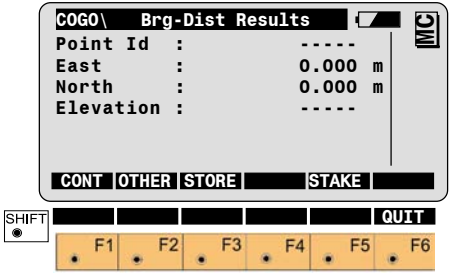
F2 Determining the radius by means of the function "**Polar calculation**" *(refer to chapter "Inverse")*.

F5 INPUT Entering radius
RCALL Call up of a radius which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction (as dialog box "Modify Distance").

SHIFT F6 Exit the program.

The following dialog box shows the result of the bearing-distance intersection:



Point Id
Entering point number of the bearing-bearing

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

F1 Return to "**Intersections**".

F2 Changing between both solutions.

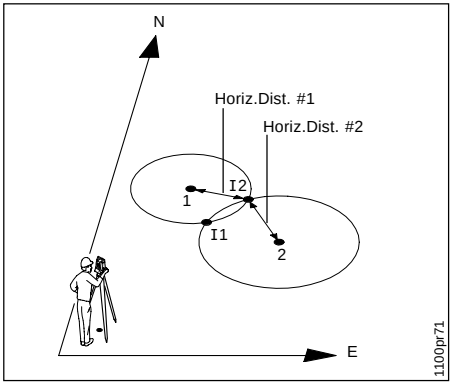
F3 The following results have been stored in the active measurement data file:

WI 11 Station Point Number
WI 81 Easting coordinate
WI 82 Northing coordinate
WI 83 Elevation (optional)

If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".
The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.

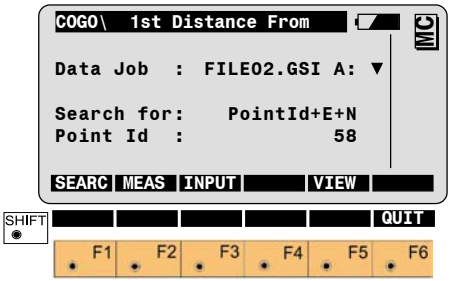


Search
- Bearing-bearing coordinates S1 and S2 (E, N)

Given
- point 1 (E, N), radius 1
- point 2 (E, N), radius 2

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 and/or 2 can be determined by measurement.

3 Call up the function "Distance-Distance" from the menu "**Intersections**".


COGO\ 1st Distance From
Data Job : FILE02.GSI A: ▼
Search for: PointId+E+N
Point Id : 58
SEARC MEAS INPUT VIEW
SHIFT QUIT
F1 F2 F3 F4 F5 F6

F1 Search for the coordinates of the first circle centre point (second circle centre point) in the datajob.

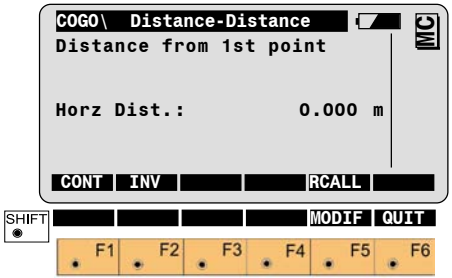
F2 Measuring the first circle centre point (2nd circle centre point).

F3 Manual entering of the first circle centre point (2nd circle centre point).

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

Enter distance from points:



Horiz.Dist.
Entering distance from first point (2nd point)

F1 Accept displayed values.

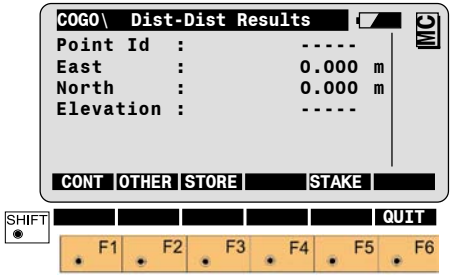
F2 Determining the radius by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT Entering radius
RCALL Call up of a radius which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(as dialog box "Modify Distance").*

SHIFT F6 Exit the program.

The following dialog box shows the result of the distance/distance intersection:



Point Id
Entering point number of the bearing-bearing

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

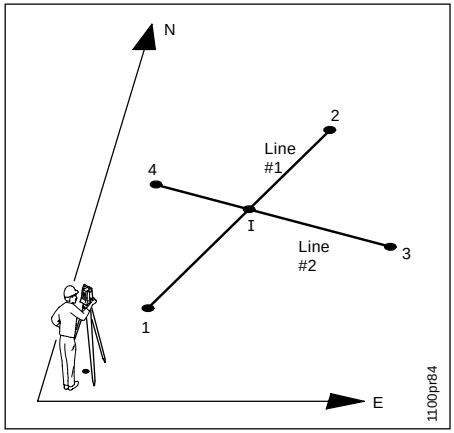
F1 Return to "**Intersections**".

F2 Changing between both solutions

F3 The following results have been stored in the active measurement data file:
WI 11 Station Point Number
WI 81 Easting coordinate
WI 82 Northing coordinate
WI 83 Elevation (optional)
If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".
The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.

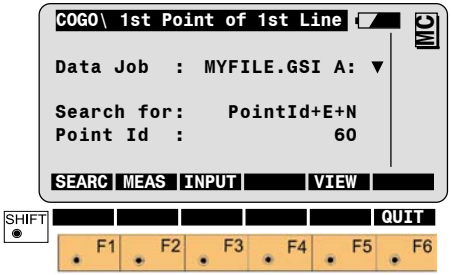


Search
- Coordinates of intersection (E, N)

Given
- Point 1 (E,N), point 2 (E,N)
- Point 3 (E,N), point 4 (E,N)

Station coordinates and orientation need to have been set correctly before the coordinates of any point can be determined by measurement.

4 Call up the function "Intersection by Points" from the menu "**Intersections**".



F1 Search for the coordinates of the 1st point of the first line (and 2nd point, as well as points defining second line) in the active data job.

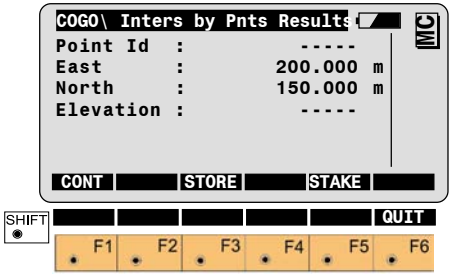
F2 Determine the point by measurement.

F3 Manually enter the point coordinates.

F5 Search for and display the coordinates of the point in the active data job.

SHIFT F6 Exit the program.

The following dialog shows the results of an Intersection by Points:



Point Id
Enter point id of the intersection point.

East
Displays east coordinate

North
Displays north coordinate

Elev.
Enter point elevation (optional).

F1 Return to "Intersections" dialog.

F3 Store the following results in the active measurement data file:

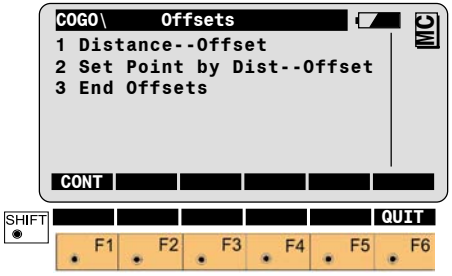
WI	11	Station point number
WI	81	Easting coordinate
WI	82	Northing coordinate
WI	83	Elevation (optional)

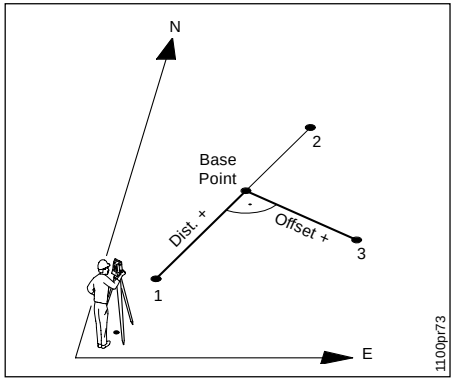
If "Point Id" has not been entered the function is not executable.

F5 Call up the program "Stakeout".
"Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered the function is not executable.

SHIFT F6 Exit the program.

4 Call up the function "Offsets" in the "**COGO MENU**"





Station coordinates and orientation need to have been set correctly before the coordinates of point 1 resp. 2 and/or point 3 can be determined by measurement.

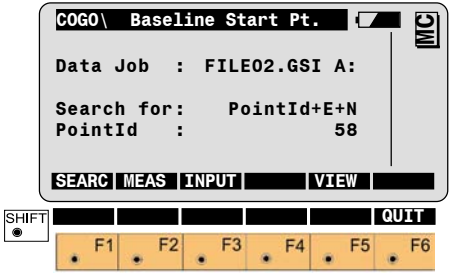
Explanation of the polarity rule of Horiz. Dist. and Offset. During entering, the polarity is based on the straight line 1 -> 2.

Search
- Difference in length/abscissa (Horiz.Dist)
- Lateral deviation/ordinate (Offset)
- Base point coordinates (E, N)

Given
- Baseline Start Point 1 (E, N),
- Baseline End Point 2 (E, N),
- lateral point 3 (E, N)

+ Offset	Parallel displacement to the right
– Offset	Parallel displacement to the left
+ Horiz.Dist.	Displacement from basis point 1 in the direction of basis point 2
– Horiz.Dist.	Displacement from basis point 1 in the opposite direction to basis point 2

1 Call up the function "Distance-Offset" from the menu "**Offsets**".



F1 Search for the coordinates of baseline start point resp. the baseline end point (or the lateral point) in the data job.

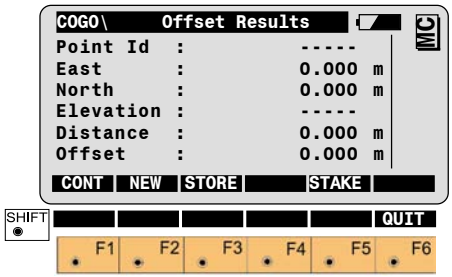
F2 Measuring the baseline start point resp. the baseline end point (or the lateral point).

F3 Manual entering of the baseline start point resp. the baseline end point (or the lateral point).

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

The following dialog box shows the results:



Point Id
Entering point number of the base point

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

Distance
Display difference in length/abscissa (Horiz. Dist.)

Offset
Display lateral deviation/ordinate (Offset)

F1 Return to the menu "**Offsets**".

F2 Entering the new lateral point with reference to the already existing basis line.

F3 The following results have been stored in the active measurement data file:

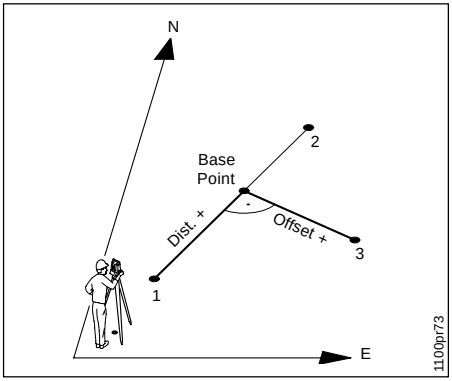
WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".

The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.



Search

- Lateral point 3 coordinates (E, N)

Given

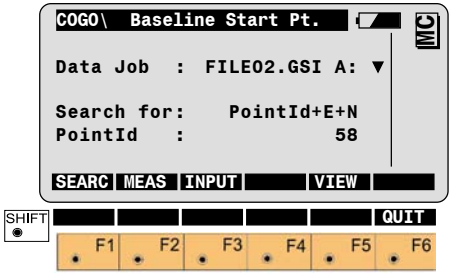
- Baseline Start Point 1 (E, N),
- Baseline End Point 2 (E, N),
- Difference in length/abscissa (Horiz. Dist.)
- Lateral deviation/ordinate (Offset)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1 resp. point 2 can be determined by measurement.

Explanation of the polarity rule of Horiz. Dist. and Offset
During entering, the polarity is based on the straight line 1 -> 2.

+ Offset	Parallel displacement to the right
– Offset	Parallel displacement to the left
+ Horiz. Dist.	Displacement from basis point 1 in the direction of basis point 2
– Horiz. Dist.	Displacement from basis point 1 in the opposite direction to basis point 2

2 Call up the function "Set Point by Dist-Offset" in the menu "**Offsets**".



F1 Search for the coordinates of baseline start point (or the baseline end point) in the data job.

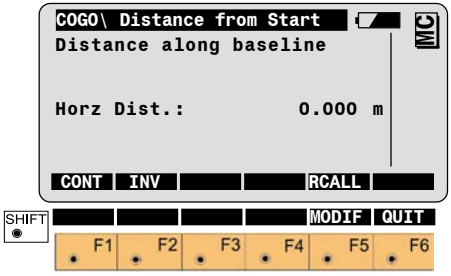
F2 Measuring the baseline start point (or the baseline end point).

F3 Manual entering of the baseline start point (or the baseline end point).

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program.

Enter distance analog baseline (Horiz. Dist.):



Horz.Dist.
Enter distance along baseline (Horiz. Dist.)

F1 Accept displayed values

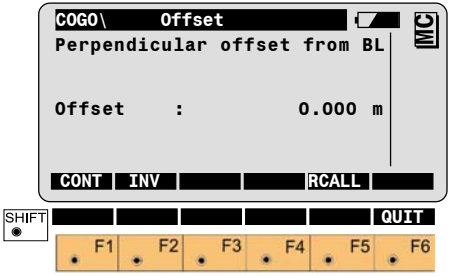
F2 Determining the distance along baseline (Horiz. Dist.) by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

F5 INPUT Entering distance along baseline
RCALL Call up of a distance along baseline which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(as dialog box "Modify Distance").*

SHIFT F6 Exit the program.

Enter lateral deviation/distance (Offset):



Horz.Dist.
Enter lateral deviation/distance (Offset)

F1 Accept displayed values.

F2 Determining the lateral deviation/distance (Offset) by means of the function "**Polar calculation**" *(refer to chapter "Inverse").*

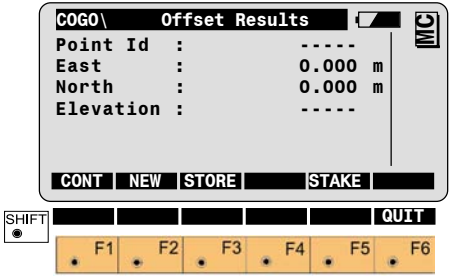
F5 INPUT Entering lateral deviation/distance

RCALL Call up of a lateral deviation/distance which has been previously stored using the function "**Polar calculation**".

SHIFT F5 Changing the direction *(as dialog box "Modify Distance").*

SHIFT F6 Exit the program.

The following dialog box shows the results of the orthogonal point calculation:



Point Id
Entering point number of the lateral point

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

F1 Return to the menu "Offsets".

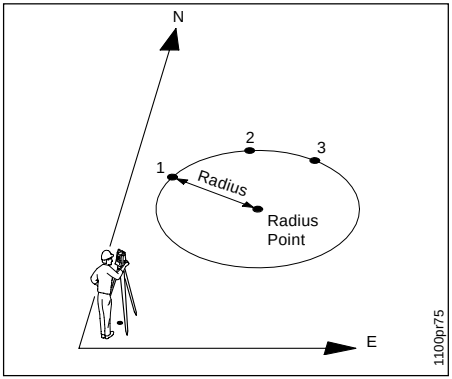
F3 The following results have been stored in the active measurement data file:

WI 11 Station Point Number
WI 81 Easting coordinate
WI 82 Northing coordinate
WI 83 Elevation (optional)

If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".
The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.

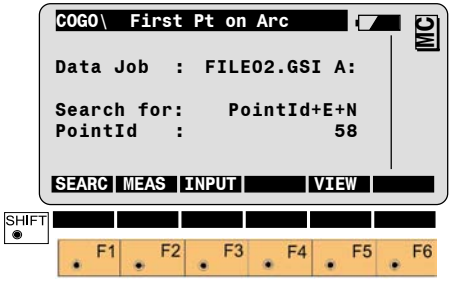


Search
- Circle centre coordinates (E, N),
- Radius

Given
- Arc point 1 (E, N),
- Arc point 2 (E, N),
- Arc point 3 (E, N)

Station coordinates and orientation need to have been set correctly before the coordinates of point 1, 2 and/or point 3 can be determined by measurement.

5 Call up the function "Three Point Arc" from the "**COGO MENU**"



F1 Search for the coordinates of the first resp. the second resp. the third arc point in the data job.

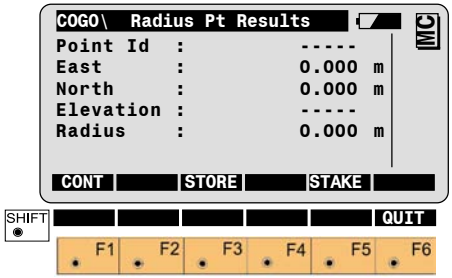
F2 Measuring the first resp. the second resp. the third arc point.

F3 Manual entering of the first resp. the second resp. the third arc point.

F5 Search and display the coordinates of the point found in the active data job.

SHIFT F6 Exit the program

The following dialog box shows the results of the calculation:



Point Id
Entering point number of the circle centre

East
Display of east coordinate

North
Display of north coordinate

Elevation
Entering height (optional)

Radius
Display of radius arc

F1 Return to the "**COGO MENU**".

F3 The following results have been stored in the active measurement data file:

WI 11	Station Point Number
WI 81	Easting coordinate
WI 82	Northing coordinate
WI 83	Elevation (optional)

If "Point Id" has not been entered, the function is not available.

F5 Call up the program "Stakeout".
The program "Stakeout" assumes that the instrument is set and oriented to a known point.
If "Point Id" has not been entered, the function is not available.

SHIFT F6 Exit the program.

Introduction

This manual describes the program "ROAD+ FILE EDITOR" of theLeica Geosystems TPS1100 Professional series.
This program is used to view and edit existing project files for the program "**Road+**" or to create new project files.

Road+ File Editor automatically applies the required file name prefixes and extensions for Road+ project files.
You may create a new Coordinate Data File, or add data to an existing one with Road+ File Editor.

1. Horizontal Alignment File
File Name: ALN?????.GSI

2. Vertical Alignment File
File Name: PRF?????.GSI

3. Template File
File Name: CRS?????.GSI

4. Station Equation File
File Name: EQN?????.GSI

5. Cross-section Assignment File
File Name: STA?????.GSI

6. Coordinate Data File
File Name: ????????.GSI

You may replace the question marks (?) in the above example file names with any DOS-permitted file name character.

Road+ File Editor may be used to create project data files for Road+, or to edit project data files that have been created by some other program like the Windows application RoadEd, available from Leica Geosystems.
The file editing options available in Road+ File Editor vary according to the type of file being edited:

You may not delete records from a Coordinate Data File, nor may you insert new records between existing records. Only the Point Id may be changed in existing records. You may add Code blocks, Point Coordinate and/or Station Coordinate Data records at only the end of the file.

You may delete, insert and/or edit all Road+ horizontal alignment element types with Road+ File Editor. Road+ horizontal alignment element types are:

- Tangents;
- Circular Curves;
- Clothoid transitions (Tangent to circular curve, circular curve to tangent and between circular curves), and;
- End of Positioning

You must use the following sign convention to describe the direction of curvature for non-tangent horizontal alignment elements:

- For right hand curves (the center of curvature is to the right of the horizontal alignment) the radius and transition parameters are positive values.
- For left hand curves (the center of curvature is to the left of the horizontal alignment) the radius and transition parameters are negative values.

You may delete, insert and/or edit all Road+ vertical alignment element types with Road+ File Editor. Road+ vertical alignment element types are:

- Tangents;
- Circular Curves;
- Parabolas, and;
- End of Positioning

You must use the following sign convention to describe the direction of curvature for non-tangent vertical alignment elements:

- For "sag" or "dip" curves (the center of curvature is above the vertical alignment) the radius and parabola parameters are positive values.

- For "crest" curves (the center of curvature is below the vertical alignment) the radius and parabola parameters are negative values.

You may insert new Cross Sections and delete and/or edit existing Cross Sections with Road+ File Editor. Cross Sections are defined by a series of straight line (tangent) elements. The elements are defined by the horizontal offsets and vertical height differences, from the location of the horizontal and vertical alignments, of the end points of the elements.

You must use the following sign convention to describe the horizontal offsets and vertical height differences of the end points of the elements:

- If the point is to the left of the horizontal alignment, the horizontal offset is negative.

- If the point is to the right of the horizontal alignment, the horizontal offset is positive.

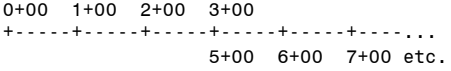
- If the point is below the vertical alignment, the vertical height difference is negative.

- If the point is above the vertical alignment, the vertical height difference is positive.

You may insert new Station Equations and delete and/or edit existing Station Equations with Road+ File Editor.

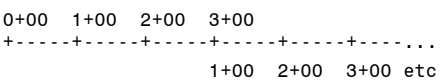
Station Equations are identified by a number, the Ahead Station and the Back Station. "Gap" and "Overlap" station equations are supported by Road+ and Road+ File Editor.

Gap Equations



In this Gap Equation example, the Ahead Station is 5+00 and the Back Station is 3+00.

Overlap Equations



In this Overlap Equation example, the Ahead Station is 1+00 and the Back Station is 3+00.

You may insert new Cross Section Assignments and delete and/or edit existing Cross Section Assignments with Road+ File Editor.
Cross Section Assignments define which Cross Section controls the shape of the project at which station. You may assign a Cross Section to any portion of an alignment by entering the starting and ending stations for which the Cross Section controls the shape of the project. Abrupt and tapered transitions between Cross Sections are possible.

Abrupt Transitions

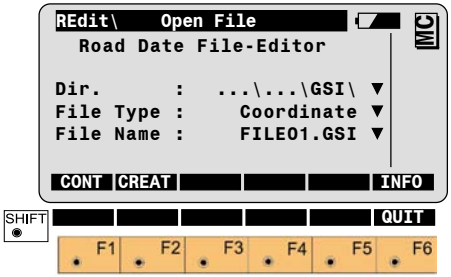
Specify the ending station of the first Cross Section. Then, specify the beginning station of the second Cross Section the smallest possible station increment ahead (typically 0.001 ft. or m.)

Tapered Transitions
Specify the ending station of the first Cross Section equal to the station at the beginning of the transition. Then, specify the beginning station of the second Cross Section equal to the station at the end of the transition. The transition may change the width and/or the shape (i.e. superelevation) of the project.

The Cross Sections at both ends of the transition must contain exactly the same number of elements.

Open file

Start program "**FILE EDITOR**" from the "**MAIN MENU: PROGRAMS**" dialog.



Path:
The PC Card in your TPS1100 Professional Series Instrument is the A:\ drive. Select any existing directory on the card to create new Road+ files, or select any existing directory containing existing files that you wish to edit.

File Type:
Select the type of file you wish to create or edit with Road+ File Editor.

Coordinate
Refer to the chapter "Coordinate Data files", page 168, in this manual for further details.

Horiz. Align
Refer to the chapter "Horizontal Alignment Files", page 173, in this manual for further details.

Vert. Align
Refer to the chapter "Vertical Alignment Files", page 178, in this manual for further details.

Cross Section
Refer to the chapter "Cross Sections Files", page 184, in this manual for further details.

Sta. Eqn.

Refer to the chapter "Station Equations Files", page 186, in this manual for further details.

CRS Assignmnt

Refer to the chapter "Cross Section Assignment Files", page 188, in this manual for further details.

File Name:
After selecting the type of file you wish to work with, you must select an existing file to edit, or press "CREAT" to create a new file of the type you have selected.

F1 Press to view and/or edit the existing file you have selected. The first record of the file will be displayed.

When you see a message that Road+ File Editor failed to read an existing file, and that file was created manually or with third party software, it usually means there is a problem with the GSI formatting of the file.

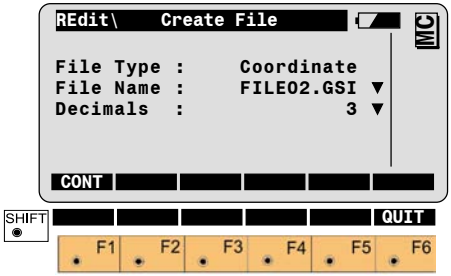
F2 Press to create a new file of the type you have selected. You will specify the name of the file on the next dialog.

F6 Press to see the date and Version number of your Road+ File Editor.

SHIFT F6 Press to Quit Road+ File Editor. This option is available on nearly every dialog within Road+ File Editor.

New Coordinate File

You will see this dialog if you selected File Type "Coordinate" and pressed "CREAT" on the previous dialog. You must specify a name for the new file. You may specify any DOS-legal file name. Road+ File Editor will apply the necessary extension for you automatically.



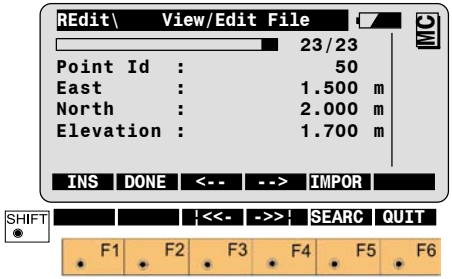
File Type
Displays the type of file that is being created.

File Name
Input any DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

F1 Press to create the new file and continue to the Insert Record dialog. (*Go to Dialog "Insert Record".*)

You will see this dialog if you selected "Insert Point Coordinates" on the previous dialog. The scrollbar at the top of this dialog graphically shows your position in the current file. The numbers to the right of the scrollbar show the number of the current record / the total number of records in the current file.



Point Id
You may edit the Point Identifier offered here, or press Enter to accept it and move to the next input field. This is the only field that may be edited in existing records.

East
The Easting or X ordinate of the point you wish to create. You may edit this value only when creating a new point.

North
The Northing or Y ordinate of the point you wish to crate. You may edit this value only when creating a new point.

Elev
The Elevation or Z ordinate of the point you wish to create. You may edit this value only when creating a new point.

F1 Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted at the end of a Coordinate Data File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

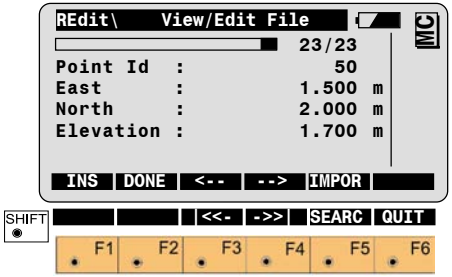
F5 Press this key to import the coordinates of a point in this or another file. This key label will not be displayed if the current record is a Code record.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Station Coordinates" on the previous dialog. The scrollbar at the top of this dialog graphically shows your position in the current file. The numbers to the right of the scrollbar show the number of the current record / the total number of records in the current file.



Point Id
You may edit the Point Identifier offered here, or press Enter to accept it and move to the next input field. This is the only field that may be edited in existing records.

East
The Easting or X ordinate of the station you wish to create. You may edit this value only when creating a new station.

North
The Northing or Y ordinate of the station you wish to crate. You may edit this value only when creating a new station.

Elev
The Elevation or Z ordinate of the station you wish to create. You may edit this value only when creating a new station.

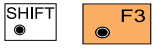
Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted at the end of a Coordinate Data File.

Press this key when you have completed all edits in the current file.

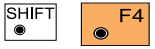
Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

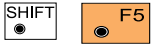
Press this key to import the coordinates of a point in this or another file. This key label will not be displayed if the current record is a Code record.



Press this key combination to display the first record in this file.

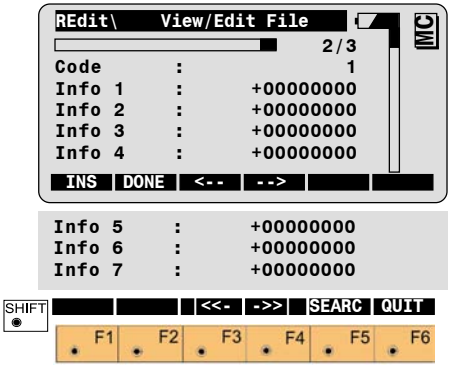


Press this key combination to display the last record in this file.



Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Code Block" on the previous dialog.



Code
Input the Code you wish to enter.

Info1 - 7
Input the Info words you wish to enter.

F1 Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted at the end of a Coordinate Data File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

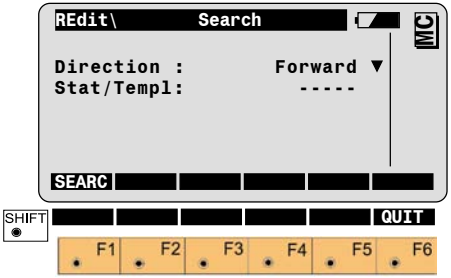
F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "SEARC" on the previous dialog.



Direction
Select the direction you wish to search from the current record. Forward searches toward the end of the file, Backward searches toward the beginning of the file.

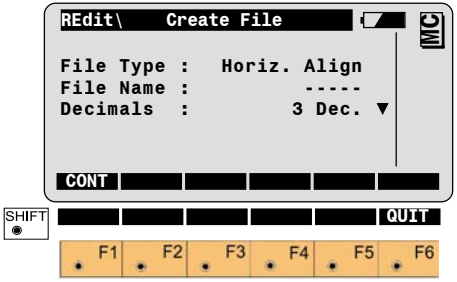
Stat/Templ
Input the Point Id or Code for which you wish to search.

F1 Press this key to search for the first occurrence of the input Point Id or Code.

If the specified Point Id or Code is found, you will see the record containing it.
If the specified Point Id or Code is not found, you will see a message. After the message, you will see the current record again.

New Horizontal Alignment File

You will see this dialog if you selected File Type "Horiz. Align" and pressed "CREAT" on the previous dialog.



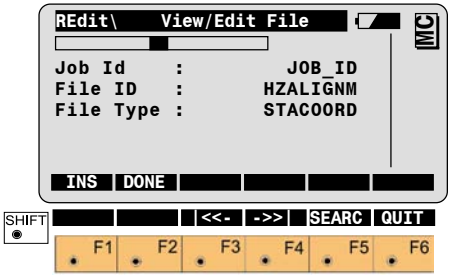
File Type
Displays the type of file that is being created.

File Name
Input any 5 character DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

F1 Press to create the new file and continue to the Header Record dialog. (Go to Dialog "View / Edit Header Record".)

You will see this dialog if you created a new or selected an existing Horizontal Alignment File.



Job Id
You may edit the Job Identifier offered here, or accept the default offered. The Job Id is used by Road+ to determine which project data files are likely to be associated together.

File Id
The File Id of a Horizontal Alignment File is "HZALIGNM" and may not be changed.

File Type
The File Type of a Horizontal Alignment File is "STACOORD" and may not be changed.

F1 Press this key when you are ready to insert a new horizontal alignment element into the file. New records will always be inserted after the currently displayed record in a Horizontal Alignment File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

F5 Press this key to import the coordinates of a point in another file.

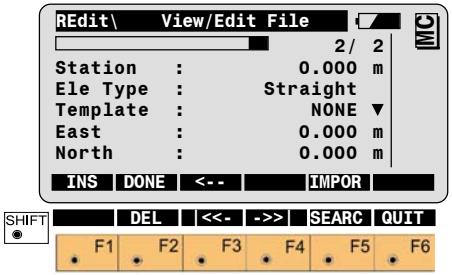
SHIFT F2 Press this key combination to delete the currently displayed record in this file. This is not available if the Header Record is displayed.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Tangent" on the Insert Record dialog in a Horizontal Alignment File.



Station
Input the Station or Chainage at the beginning of the element.

Ele Type
Straight

Template
Input the name of the Cross Section you wish to associate with this Horizontal Alignment element. This may be "NONE" if you are using a Cross Section Assignment File as a part of this Road+ project, or if this Road+ project does not include Cross Sections.

East
The Easting or X ordinate at the beginning of the element.

North
The Northing or Y ordinate at the beginning of the element.

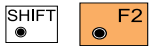
Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted after the currently displayed record in a Horizontal Alignment File.

Press this key when you have completed all edits in the current file.

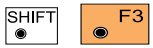
Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

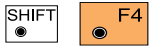
Press this key to import the coordinates of a point in another file.



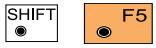
Press this key combination to delete the currently displayed record in this file. This is not available if the Header Record is displayed.



Press this key combination to display the first record in this file.

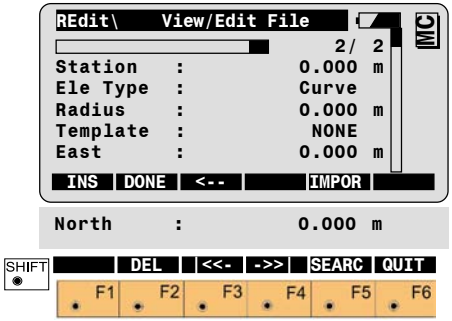


Press this key combination to display the last record in this file.



Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Circular Curve" on the Insert Record dialog in a Horizontal Alignment File.



Station
Input the Station or Chainage at the beginning of the element.

Ele Type
Curve

Radius
Input the Radius of the Circular Curve.

Template
Input the name of the Cross Section you wish to associate with this Horizontal Alignment element.

East
The Easting or X ordinate at the beginning of the element.

North
The Northing or Y ordinate at the beginning of the element.

F1 Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted after the currently displayed record in a Horizontal Alignment File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

F5 Press this key to import the coordinates of a point in another file.

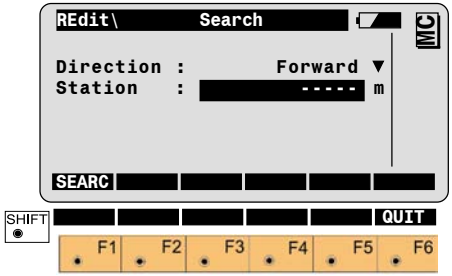
SHIFT F2 Press this key combination to delete the currently displayed record in this file. This is not available if the Header Record is displayed.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "SEARC" on the previous dialog.



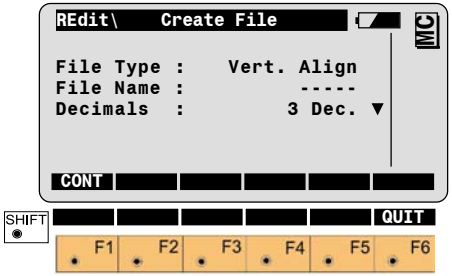
Direction
Select the direction you wish to search from the current record.

Station
Input the Station for which you wish to search.

F1 Press this key to search for the input Station.

New Vertical Alignment File

You will see this dialog if you selected File Type "Vert. Align" and pressed "CREAT" on the previous dialog.



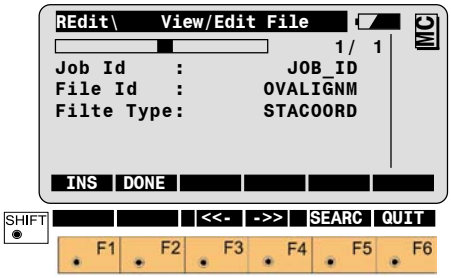
File Type
Displays the type of file that is being created.

File Name
Input any 5 character DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

F1 Press to create the new file and continue to the Header Record dialog. (*Go to Dialog "View / Edit Header Record".*)

You will see this dialog if you created a new or selected an existing Vertical Alignment File.



Job Id
You may edit the Job Identifier offered here, or accept the default offered.

File Id
The File Id of a Vertical Alignment File is "VALIGNM" and may not be changed.

File Type
The File Type of a Vertical Alignment File is "STACOORD" and may not be changed.

F1 Press this key when you are ready to insert a new vertical alignment element into the file. New records will always be inserted after the currently displayed record in a Vertical Alignment File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

F5 Press this key to import the elevation of a point in another file.

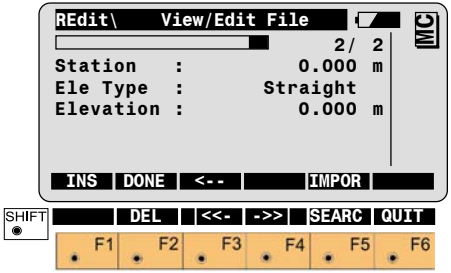
SHIFT F2 Press this key combination to delete the currently displayed record in this file. This is not available if the Header Record is displayed.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Tangent" on the Insert Record dialog in a Vertical Alignment File. A Tangent is a straight element in an alignment.



Station
Input the Station or Chainage at the beginning of the element.

Ele Type
Straight

Elevation
The Elevation or Z ordinate at the beginning of the element.

F1 Press this key when you have completed the edits of the current record and are ready to insert a new record. New records will always be inserted after the currently displayed record in a Vertical Alignment File.

F2 Press this key when you have completed all edits in the current file.

F3 Press this key to display the record before the currently displayed record in this file. This key label will not be displayed if the current record is the first record in the file.

F4 Press this key to display the record after the currently displayed record in this file. This key label will not be displayed if the current record is the last record in the file.

F5 Press this key to import the elevation of a point in another file.

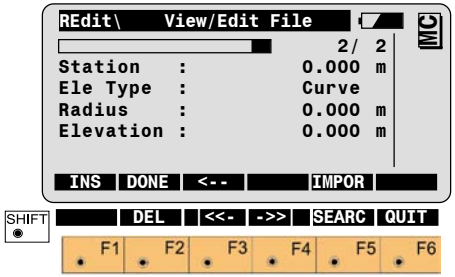
SHIFT F2 Press this key combination to delete the currently displayed record in this file. This is not available if the Header Record is displayed.

SHIFT F3 Press this key combination to display the first record in this file.

SHIFT F4 Press this key combination to display the last record in this file.

SHIFT F5 Press this key combination to search for a particular record in this file. (*Go to Dialog "Search"*)

You will see this dialog if you selected "Insert Circular Curve" on the Insert Record dialog in a Vertical Alignment File. A Circular Curve is a curve of constant radius in the alignment.



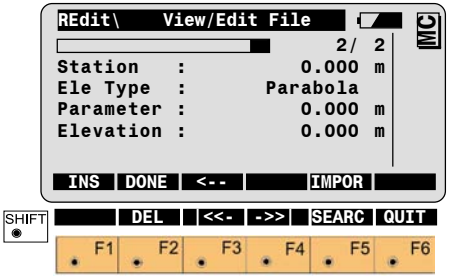
Station
Input the Station or Chainage at the beginning of the element.

Ele Type
Curve

Radius
Input the Radius of the Circular Curve.

Elevation
The Elevation or Z ordinate at the beginning of the element.

You will see this dialog if you selected "Insert Parabola" on the Insert Record dialog in a Vertical Alignment File.



Station
Input the Station or Chainage at the beginning of the element.

Ele Type
Parabola

Parameter

Input the Parameter of the Parabola ("p").

For "sag" or "dip" curves (the center of curvature is above the vertical alignment) the Parameter is a positive value.

For "crest" curves (the center of curvature is below the vertical alignment) the Parameter is a negative value.

The "p" parameter is the reciprocal of the rate of change of slope in the vertical curve:

$$p = L / (G_{OUT} - G_{IN})$$

or

$$p = (Y_I - Y_S)^2 / 2(X_I - X_S)$$

Where

G_{OUT} = the slope of the vertical alignment at the end of the vertical curve, as a decimal fraction (not percent);

G_{IN} = the slope of the vertical alignment at the beginning of the vertical curve as a decimal fraction (not percent), and;

L = the horizontal distance from the beginning to the end of the vertical curve.

and:

Y_I = The elevation above datum of any point on the vertical curve;

Y_S = The elevation above datum at the low or high point of the vertical curve;

X_I = The station or chainage of any point on the vertical curve;

X_S = The station or chainage at the low or high point of the vertical curve;

The general equation for a parabola is:

$$Y = aX^2 + bX + c$$

When the parabola describes a vertical curve in an alignment:

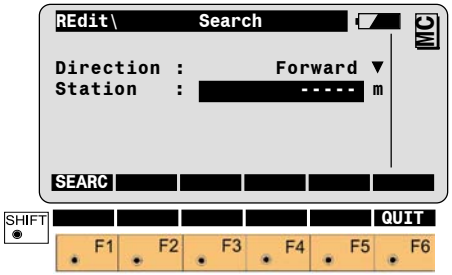
Y = The elevation above datum of a point on the vertical curve;
X = The horizontal distance from the beginning of the vertical curve;
a = One half of the rate of change of slope in the vertical curve;
b = The slope of the vertical alignment, as a decimal fraction (not percent), at the beginning of the vertical curve, and;
c = The elevation above datum at the beginning of the vertical curve.

Therefore, the "p" parameter may also be expressed as:

$$p = \tfrac{1}{2}a$$

Elevation
The Elevation or Z ordinate at the beginning of the element.

You will see this dialog if you selected "SEARC" on the previous dialog.



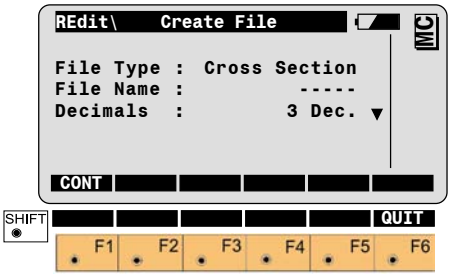
Direction
Select the direction you wish to search from the current record.

Station
Input the Station for which you wish to search.

Press this key to search for the input Station.

New Cross Section File

You will see this dialog if you selected File Type "Cross Section" and pressed "CREAT" on the previous dialog.



File Type
Displays the type of file that is being created.

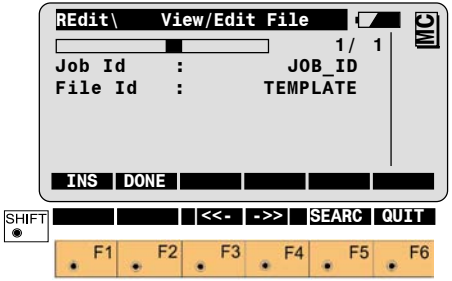
File Name
Input any 5 character DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

F1 Press to create the new file and continue to the Header Record dialog. (*Go to Dialog "View / Edit Header Record".*)

Header Record

You will see this dialog if you created a new or selected an existing Cross Section File.

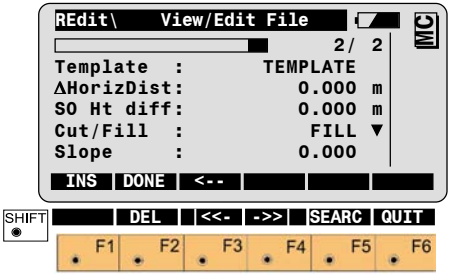


Job Id
You may edit the Job Identifier offered here, or accept the default offered. The Job Id is used by Road+ to determine which project data files are likely to be associated together.

File Id
The File Id of a Cross Section File is "TEMPLATE" and may not be changed.

You will see this dialog if you selected "INS" on the Header Record dialog in a Cross Section File.

The points defining a Cross Section must be entered in sequence from the farthest left to the farthest right on the Cross Section. The points defining a Cross Section should be entered consecutively to minimize file access during the operation of Road+.



Template
Input the name of the template, if you are going to create a new one or change the name of an existing one. Otherwise, this field displays the name of the Template you are currently editing.

ΔHorizDist
Input the horizontal distance from the Horizontal Alignment to the point you wish to create or edit.
For points to the right of the Horizontal Alignment, ΔHorizDist is a positive number. For points to the left of the Horizontal Alignment, ΔHorizDist is a negative number.

SO Ht diff
Input the vertical distance from the Vertical Alignment to the point you wish to create or edit.

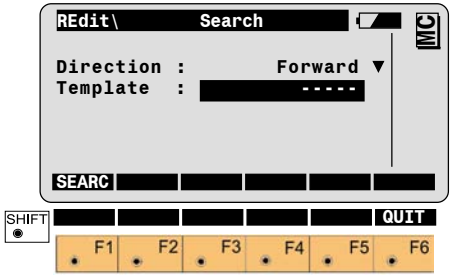
For points above the Vertical Alignment, SO Ht diff is a positive number. For points below the Vertical Alignment, SO Ht diff is a negative number.

Cut/Fill
(Optional) Select a description for the current Cross Section.

- **Cut** means the hinge point is below the existing surface of the ground.
- **Fill** means the hinge point is above the existing surface of the ground.
- **Standard** means the hinge point is not specifically identified as being above or below the existing surface of the ground (the "Cut/Fill" and "Slope" information are omitted from the file.)

Slope (Optional)
The ratio of the Δ Horizontal Distance to the Δ Vertical Distance from the Hinge Point to the existing ground. The slope must be assigned only to the first and last points (hinge points) in a Cross Section. All points falling between the hinge points must have a slope of zero.
If the design surface is rising toward the right, the slope is a positive value. If the design surface is falling toward the right, the slope is a negative value.

You will see this dialog if you selected "SEARC" on the previous dialog.



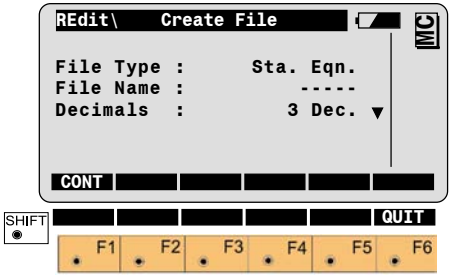
Direction
Select the direction you wish to search from the current record.

Template
Input the Cross Section name or number for which you wish to search.

Press this key to search for the input Cross Section name or number.

New Station Equation File

You will see this dialog if you selected File Type "Station Equation" and pressed "CREAT" on the previous dialog.

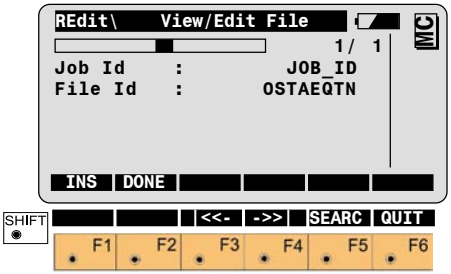


File Type
Displays the type of file that is being created.

File Name
Input any 5 character DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

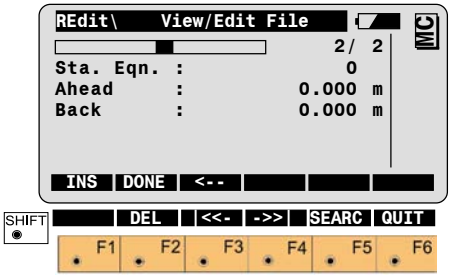
You will see this dialog if you created a new or selected an existing Station Equation File.



Job Id
You may edit the Job Identifier offered here, or accept the default offered. The Job Id is used by Road+ to determine which project data files are likely to be associated together.

File Id
The File Id of a Station Equation File is "STAEQTN" and may not be changed.

You will see this dialog if you selected "INS" on the Header Record dialog in a Station Equation File.

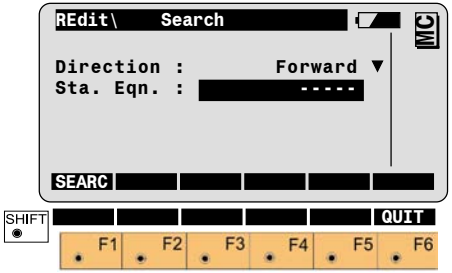


Sta. Eqn.
The number, starting from 1, of the equation in the Horizontal Alignment.

Ahead
The value from which the Stationing continues forward along the Horizontal Alignment.

Back
The value from which the Stationing decreases backward along the Horizontal Alignment.

You will see this dialog if you selected "SEARC" on the previous dialog.

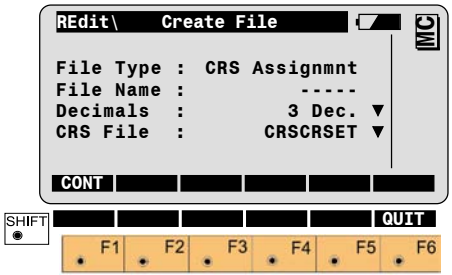


Direction
Select the direction you wish to search from the current record.

Sta. Eqn.
Input the Station Equation number for which you wish to search.

New Cross-section Assignment File

You will see this dialog if you selected File Type "CRS Assignmnt" and pressed "CREAT" on the previous dialog.



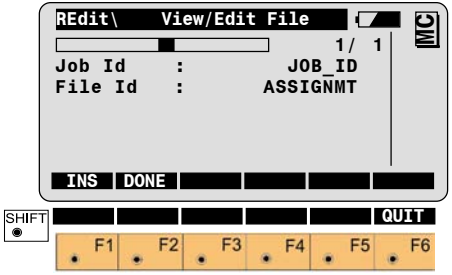
File Type
Displays the type of file that is being created.

File Name
Input any 5 character DOS-legal file name.

Decimals
Select the number of decimal places to be used in this file.

CRS File
Select the Cross Section File with which this Cross-section Assignment File is associated. (The Cross Sections assigned by this file must be defined in the associated Cross Section File.)

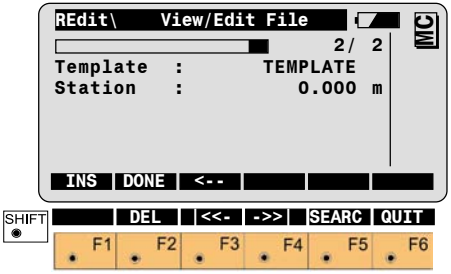
You will see this dialog if you created a new or selected an existing Station Equation File.



Job Id
You may edit the Job Identifier offered here, or accept the default offered.

File Id
The File Id of a Cross-section Assignment File is "ASSIGNMT" and may not be changed.

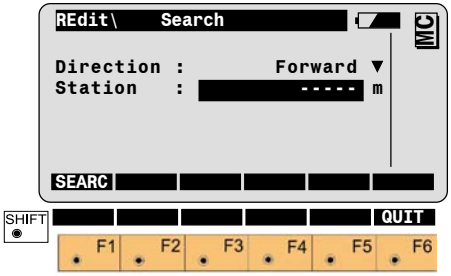
You will see this dialog if you selected "INS" on the Header Record dialog in a Cross-section Assignment File.



Template
The name (or number) of the Cross Section to be assigned.

Station
The Station at which the assignment begins.

You will see this dialog if you selected "SEARC" on the previous dialog.



Direction
Select the direction you wish to search from the current record.

Station
Input the Station for which you wish to search.

Introduction

This manual describes the "ROAD+" program of the TPS1100 Professional Series.

The program uses the station and offset method to control contsruction staking of roads and other types of curvilinear projects. The program supports station equations, cross section assignment by station, cross section definition, cross section interpolation, automatic superelevation and widening, and slope staking/catch points.

Alignment Definition

An alignment consists of three basic components which are horizontal alignment, vertical alignment and cross-section template. Of these, a horizontal alignment is mandatory to use "ROAD+". All other alignment elements are optional.

"ROAD+" reads the elements of each of these components from data files that are in GSI file format. In addition, a file can be created for entering cross-section stations for specific locations such as points needed for the staking of superelevation points. If station equations are needed, "ROAD+" will read a file created for station equations and apply the appropriate corrections.

Data Files

Each of the data files "ROAD+" reads contain the necessary information specific to the component being defined. The files have unique identifiers and must be in the GSI file format:

Horizontal Alignment File..... ALN?????.GSI
Vertical Alignment File.....PRF?????.GSI
Template File ..... CRS?????.GSI
Cross-section Assignment File..... STA?????.GSI
Station Equation File..... EQN?????.GSI

The three letter prefix, ALN, PRF, CRS, STA and EQN identify the type of file and must be used when creating the data files. The ? can be any valid DOS character. The file extension GSI defines the file as a GSI file and must be used.

1. Permitted elements in the Hz-alignment

Straight defined by station (chainage) and coordinates of starting point

Curve defined by station (chainage) and coordinates of starting point and
Radius of curve (– = left-hand curve; + = right-hand curve)

Spiral between a Straight and a Curve, defined by station (chainage) and coordinates of starting point; and Parameter A[1] of spiral (negative parameter = spiral into or from left-hand curve)

Curve In Clothoid transition between a Curve of larger radius and a Curve of smaller radius, defined by station (chaingage) and coordinates of starting point; and
Radius of larger curve; and
Radius of smaller curve

Curve out Clothoid transition between a Curve of smaller radius and a Curve of larger radius, defined by station (chaingage) and coordinates of starting point; and
Radius of smaller curve; and
Radius of larger curve

End of project (EOP) station (chainage) and coordinates of end-point

[1] $\mathbf{A = \sqrt{L \times R}}$, where L=length of spiral, R=radius of curve

2. Permitted elements in V-alignments

Straight defined by station (chainage) and height of starting point

Curve defined by station (chainage) and height of starting point and radius of curve
(– = crest; + = dip)

Parabola defined by station (chainage) and height of starting point, and parameters of parabola[2] (– = crest; + = dip)

End of project (EOP) station (chainage) and height of end-point of gradient

[2] Parabola parameter formulae:

$p=(S-S_0)^2 / 2(H-H_0)$

Where:

- S = any station (chainage) on the parabola
- S_0 = station (chainage) of the high/low point of the parabola
- H = height at any station S (above), and
- H_0 = height of the high/low point of the parabola

OR

$p = L / (G_{OUT} - G_{IN})$

Where:

- G_{OUT} = the slope of the vertical alignment at the end of the vertical curve, expressed as a decimal fraction (not percent);
- G_{IN} = the slope of the vertical alignment at the beginning of the vertical curve, expressed as a decimal fraction (not percent), and;
- L = the horizontal distance from the beginning to the end of the vertical curve.

OR

p = 1 / 2a,
in the general equation
$Y = aX^2 + bX + c$ for a parabola as used to describe a vertical curve in an alignment.

Where:

- Y = The height of a point on the vertical curve;
- X = The horizontal distance of the point from the beginning of the vertical curve;
- a = One half of the rate of change of slope in the vertical curve;
- b = The slope of the vertical alignment at the beginning of the vertical curve, and;
- c = The height above datum at the beginning of the vertical curve.

3. Permitted elements in cross sections

If both cuts and fills exist in your project, you must define cut and fill cross sections for your project.

Offset from horizontal alignment

Height difference from vertical alignment[3]

[3] A vertical alignment is required in order to use cross sections in ROAD+.

4. Permitted elements in cross section assignments

Name The name or number of the cross section

Station The station (chainage) at which the cross section is to be applied

5. Permitted elements in station equations

Station equation sequence number

Back Station The last station (chainage) leading up to the equation

Ahead Station The first station (chainage) continuing away from the equation

There are two methods that can be used to create the necessary Road+ input data files.

- The Windows application, RoadEd; and
- The TPS1100 Professional Series instrument program, Road+ File Editor.

If the program called "Road+ FILE EDITOR" is loaded into the theodolite, all necessary data can be entered through the keyboard of your TPS1100 Professional Series instrument.

To enter the data on the computer, a Windows application called "RoadEd" can be used. If you create the files using "RoadEd", the files must be copied to the PCMCIA card.

"ROAD+" allows measurements in one telescope position only. A typical "ROAD+" session includes the following steps:

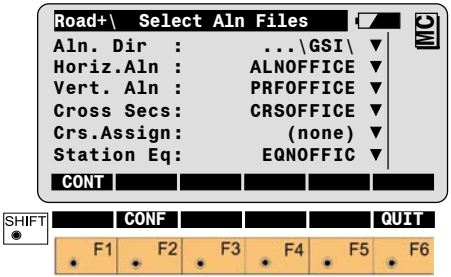
1. Enter setup information for the instrument and orient.
2. Start the ROAD+ program and configure.
3. Select the alignment files
4. Select a station
5. Pick a point on the cross-section to stakeout, enter an offset, choose method.
6. Stake the point and record the data.
7. Choose another point on the cross-section and stake it out.
8. When all selected points on the cross section have been staked, enter a new station and repeat steps 5-7.

In the sections that follow, operation of the program will be covered in more detail. This will assist you to become proficient with the "ROAD+" program for normal everyday operations, such as staking a project with stations and offsets, and slope staking.

Before starting the program, enter the setup information for the location of the theodolite and orient the instrument to the reference point.

From the "MAIN MENU: PROGRAMS" display, move the highlighted cursor to the "ROAD+" program and press on the keyboard of the instrument. This will bring up the "Select Aln Files" dialog.

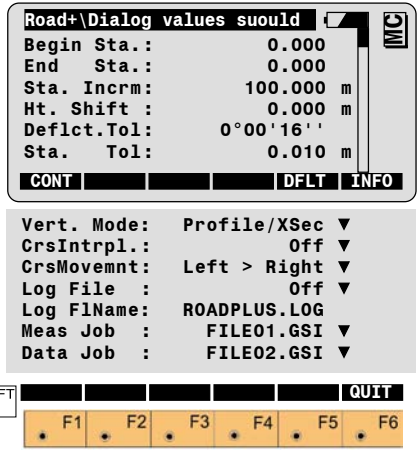
The display illustration examples contain text and values for example purposes only. The actual values you will see on the display of your instrument will be different.



SHIFT F2 Call up the "Configuration-Editor".

Before selecting the alignment files to use, you should enter the configuration parameters for the job.

SHIFT F2 Start the "Configuration-Editor" from the "Select Aln Files" dialog.



Begin Sta.
Enter the beginning station (chainage) for your work area

End Sta.
Enter the ending station (chainage) for your work area

Sta. Incrm
Enter the station (chainage) interval to be used

Ht. Shift
Enter a vertical shift value if needed. The value entered will be applied to the whole alignment.

Deflct. Tol.
Enter an angle tolerance for deflection angles. Make this a small value but not 0.

Sta. Tol.
Enter a value for stationing (chainage) tolerance.

Vert. Mode
The normal mode is Profile/XSec. However, if you have installed the TPS1100 Application DTM Stake, you will see an additional option here. Profile/XSec uses a vertical alignment and cross sections to define the project in the vertical direction. DTM uses a digital terrain model to define the project in the vertical direction.

Crs Intrpl
The cross section interpolation can be switched ON or OFF. More details are described in chapter "Cross section definition".

CrsMovemnt
This function controls the movement along the cross section.
There are three choices:
- LEFT to RIGHT,
- RIGHT to LEFT and
- NONE.

The direction chosen is for display purposes only. The rodperson can go in any direction desired along the cross section.

Log file
When the log file is set to ON, staked out data can be stored in a file for printing at a later date.

Log FlName
Enter a file name for the log file. The default file name can be used. LogFlName appears only if "Log File = ON" is selected in the "Configuration".

Meas Job
Selection of the measurement job for recording measurements.

Data Job
Selection of the data job containing the fix point coordinates (control data).

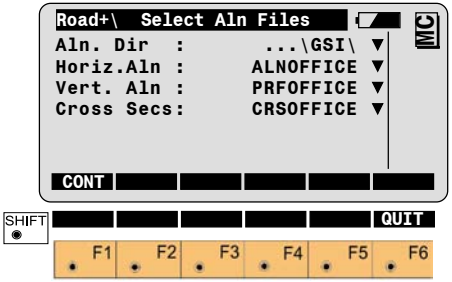
F1 Accepts and stores parameters displayed. Continues to display "SELECT ALN FILES"

F5 Sets standard values. The values are displayed in dialog on page 195.

F6 Displays date and version of the program.

To proceed further, you must select a horizontal alignment file. The other files are optional and are dependent on what you are staking. For instance, if you are only staking the centerline of the road, then it would not be necessary to have a vertical alignment, template, cross section assignment or station equation file. If your project requires these other files then you will need to select them here.

All alignment files must be stored in the same directory on the memory card.



Horizontal Alignment File

The Horizontal Alignment file defines the plan view shape of the project centerline.

Select the horizontal alignment file. A dialog box appears with a list of all ALN?????.GSI files available. Move the cursor to the file needed and press .
The "Select Aln File" display will return and the cursor will be highlighting the Vertical Alignment file.

Vertical Alignment File

The Vertical Alignment file defines the height of the project centerline.

Select the vertical alignment file. A dialog box appears with a list of all PRF?????.GSI files available. Move the cursor to the file needed and press .
The "Select Aln File" display will return and the cursor will be highlighting the Cross Section file.

Cross Section/template File

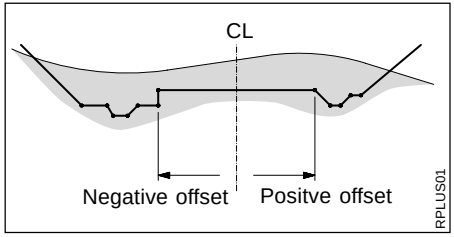
The Cross Section file defines the cross-sectional shape of the project.

Select the cross section file. A dialog box appears with a list of all CRS?????.GSI files available. Move the cursor to the file needed and press .
The "Select Aln File" display will return and the cursor will be highlighting the Cross Section Assignment file.

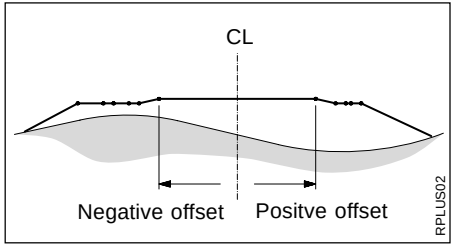
Cross Section Definition

When defining the cross section, both a cut and fill template can be created similar to the following diagrams.

Cross section - Cut



Cross section - Fill



CL = Centerline

The cross section assignment file contains the following elements:

- Cross Section name
- Controlling Chainage

Road+ treats the data in the Cross Section Assignment File in two different ways, according to the setting of the CRS Intrpl switch in the configuration routine.
When CRS Intrpl is set to OFF, a cross section assigned in this file will remain in effect until another cross section is defined. The transition between the two cross sections will be abrupt, at the station where the next cross section assignment takes effect. When the file is created you will designate the name of the template to use and the chainage to begin using the template. The next template name entered also contains a starting chainage. A third template can be assigned to begin at another chainage and so forth.

For example, the file might contain the following information:

XSEC1, 0
XSEC2, 100
XSEC3, 300
XSEC1, 550

Road+ would use template XSEC1 beginning at station (chainage) 0+00 and ending at station (chainage) 1+00, XSEC2 beginning at station (chainage) 1+00 and ending at station (chainage) 3+00, XSEC3 from station (chainage), 3+00 to station (chainage) 5+50, and use XSEC1 again, beginning at station (chainage) 5+50.

When CRS Intrpl is set to ON, this same data would be treated differently, assuming all three cross section templates have the same number of points in them.

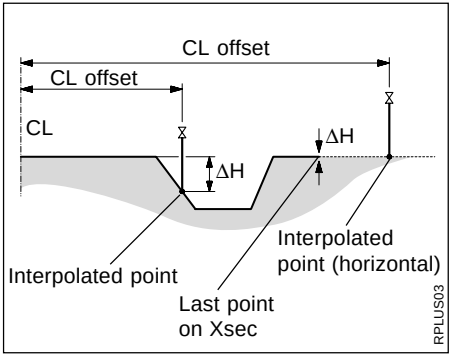
Road+ would start with XSEC1 at station (chainage) 0+00, and transition linearly to XSEC2 at station 1+00. Then it would transition linearly to XSEC3 at station (chainage) 3+00, and finally transition linearly back to XSEC1 at station (chainage) 5+50. If the project continues past station (chainage) 5+50, XSEC1 will be applied.

Select the cross section assignment file. A dialog box appears with a list of all STA?????.GSI files available. Move the cursor to the file needed and press .

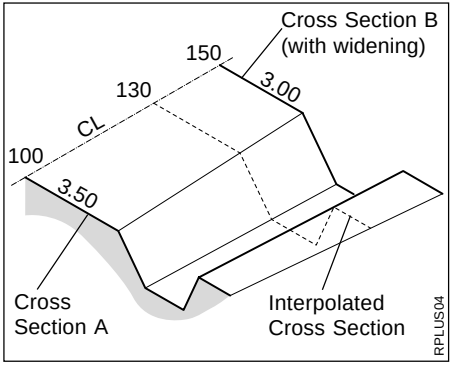
- **Cross Section Interpolation**

Cross sections can be interpolated both along the cross section (i.e. between defined points), and between cross sections themselves. The interpolation between cross sections makes superelevation and widening possible. The following diagrams illustrate these concepts.

Interpolation along a cross section:



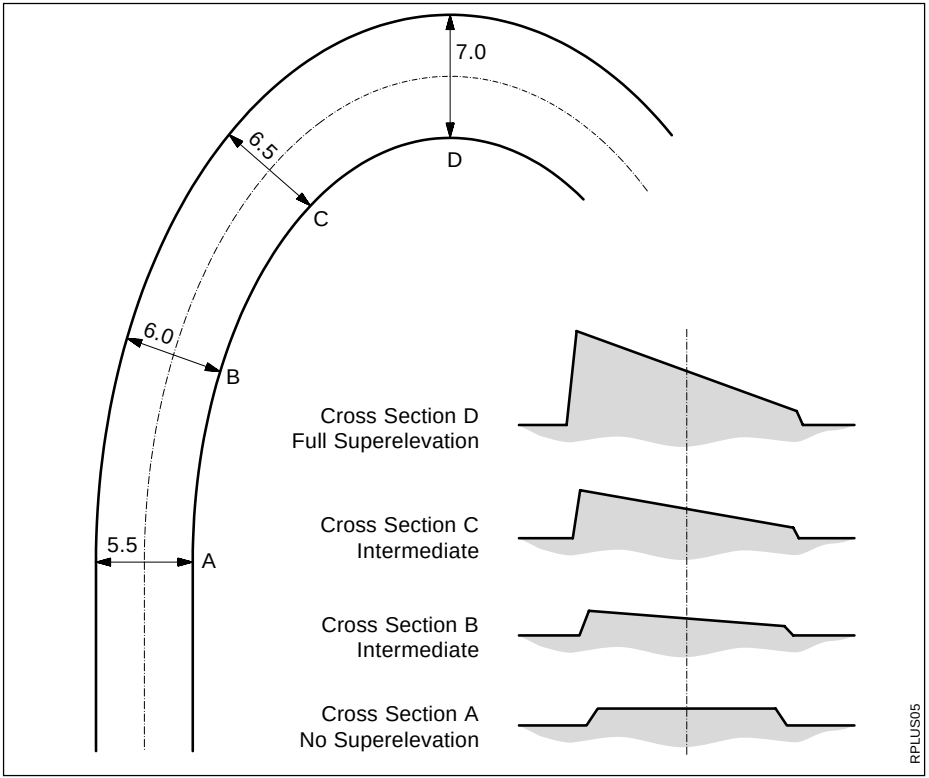
Interpolation between cross sections:



- **Superelevation/Widening**

Superelevation is controlled by the cross sections. Cross sections must be placed at the appropriate chainage for the beginning of superelevation, full superelevation and back to no superelevation. The STA?????.GSI file contains these special locations for cross sections as well as cross section locations for widening. The diagram that follows illustrates the concept for superelevation.

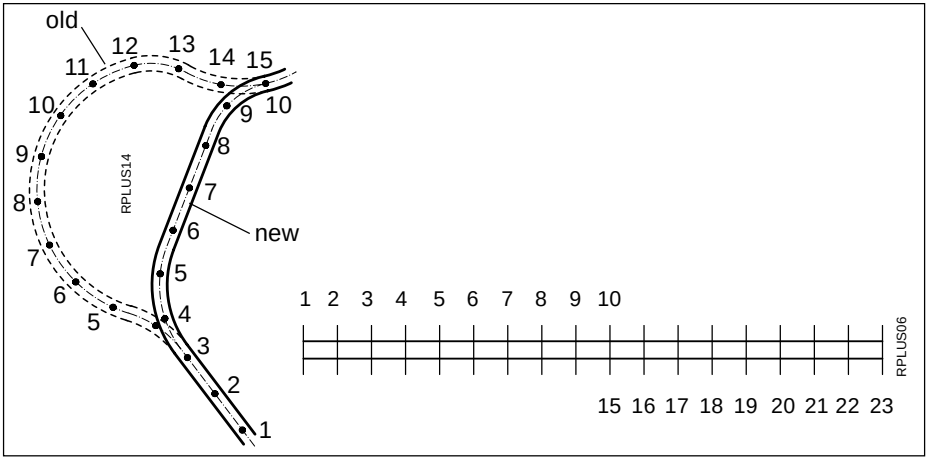
Superelevation governed by cross sections:



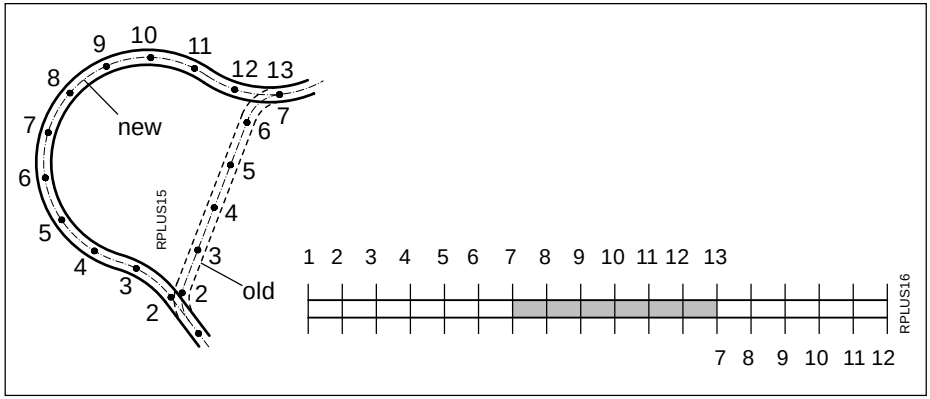
Station equations are used to adjust the alignment stationing. The most common reason for doing so is the insertion or removal of curves during the design process. Inserting or removing a curve would require re-calculating the stationing of an entire alignment. Using station equations eliminates this.

Station equations can create either a gap or overlap as shown in the following diagrams.

Gap Station Equation
Station Back 10+000 = Station Ahead 15+000



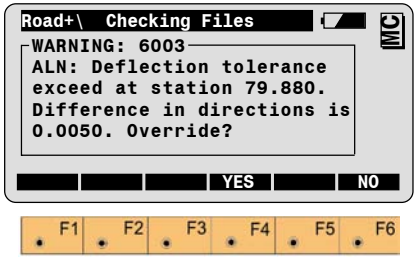
Overlap Station Equation
Station Back 13+000 = Station Ahead 7+000



Select the station equation file. A dialog box appears with a list of all EQN?????.GSI files available. Move the cursor to the file needed and press .

F1 When all files have been selected. Continues to display "Station & OFFSET". Prior to the "Station & OFFSET" display appearing, you will see a brief message about checking for errors in the selected files.

During the file checking process, each file is inspected for possible errors in the data format such as missing or incorrect word index. If errors are found, an error message is displayed indicating the type of error. During the inspection process, if any errors are found that would cause erroneous data to be computed and displayed, the file checking routine will be aborted. If this occurs, the file(s) containing the problem must be fixed before continuing. In addition to checking for file errors, geometrical components are checked. This includes tangent directions of adjacent elements and chord lengths of elements. Any deviations which exceed permitted tolerances are displayed such as in the following example.



F6 Selecting the "NO" option to override will bring up another display that says "Continue checking alignment ?". If you choose "NO" the display will return to the "SELECT ALN FILES" menu. If you choose "YES" the program will continue to check the files. If no other errors are found the program will go to the opening "Station & Offset" display.

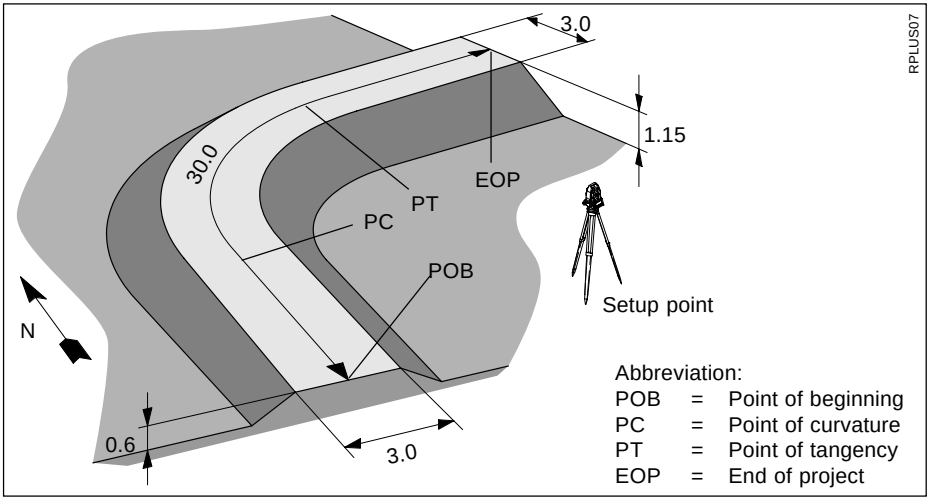
F4 Selecting the "YES" option to override will cause the program to override the error and continue to check other files for possible errors. If no other errors are found the program will go to the "Station & Offset" opening display.

Preparing for the example

The most common method for staking out roads, pavement, curb & gutter etc. is to use a horizontal offset from the actual point. For instance, a four foot offset from finished back of curb (BC) is commonly used to provide cut/fill stakes for a street and curb lines.

In this section of the manual, a sample project will be used to demonstrate the procedures to follow for staking a portion of the job. The project consists of a 3 m wide paved bicycle path with a curve. The project will be staked on a 0.6 m offset from the edge of pavement. The POB and PC will be staked for both sides.

This project also uses a simple template. The project is designed to illustrate the application of the "ROAD+" Program . It is not intended to provide a demonstration of road design procedures.



Our bike path is about 30 m in length as illustrated here. The riding surface is 3 m wide, lying 1.5 m on each side of the centerline. From the edge of the riding surface, fill slopes extend downward at a slope of 2:1.

The vertical alignment (or profile) for the project is a simple 2% uphill slope. An assumed elevation of 30.50 is placed on the original ground at the Setup Point, and the road starts at elevation 31.1. This allows you to practice with all of the components of the "ROADPLUS" program. For the field work, we recommend a flat, open area about 25 m on a side.

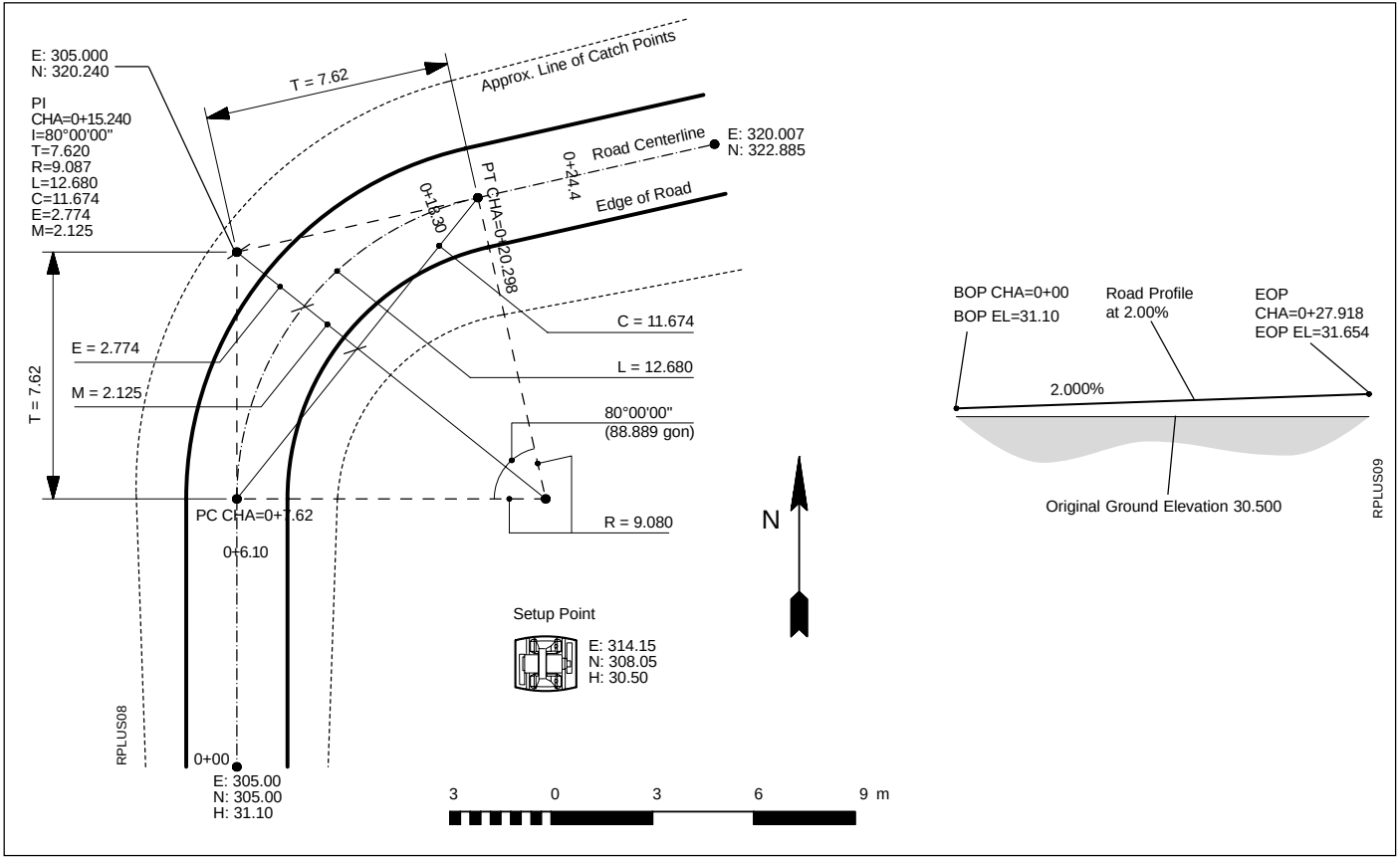
The following pages contain illustrations and listings of all the data needed to run the example.

There are 3 easy steps to the example:

1. Use the "RoadEd" program on your PC, or Road+ File Editor on your TPS1100 Professional Series Instrument, to enter the design information for the Horizontal Alignment, Vertical Alignment, and Templates.
   A special naming convention identifies the type of file that each alignment and template are stored in. The first three letters in the file name tell "ROADPLUS" what is in the file and how to view it. The GSI extension is also required.

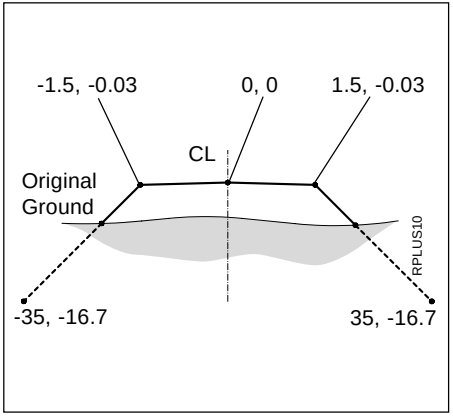
Horizontal Alignment:	ALN?????.GSI
Vertical Alignment:	PRF?????.GSI
Templates:	CRS?????.GSI

In "RoadEd", enter the following example project data. Let's call the project "EXAMPLE" and configure the units to m, 3 decimal places. Let's name the files "ALN_EX1.GSI", "PRF_EX1.GSI", and "CRS_EX1.GSI".


E: 305.000
N: 320.240
PI
CHA=0+15.240
I=80°00'00"
T=7.620
R=9.087
L=12.680
C=11.674
E=2.774
M=2.125
T = 7.62
Approx. Line of Catch Points
Road Centerline
E: 320.007
N: 322.885
Edge of Road
0+24.4
0+18.30
PT CHA=0+20.298
C = 11.674
L = 12.680
80°00'00"
(88.889 gon)
R = 9.080
E = 2.774
M = 2.125
T = 7.62
PC CHA=0+7.62
0+6.10
0+00
E: 305.00
N: 305.00
H: 31.10
RPLUS08
Setup Point
E: 314.15
N: 308.05
H: 30.50
N
3 0 3 6 9 m
BOP CHA=0+00
BOP EL=31.10
Road Profile
at 2.00%
EOP
CHA=0+27.918
EOP EL=31.654
2.000%
Original Ground Elevation 30.500
RPLUS09

Horizontal Alignment: ALN_EX1.GSI					
Station	**Element**	**Rad/Par**	**Template**	**E**	**N**
0.000	Straight	0.000	Tutor	305.000	305.000
7.620	Curve	9.080	Tutor	305.000	312.620
20.298	Straight	0.000	Tutor	312.502	321.562
27.918	EOP	0.000	Tutor	320.007	322.885

Vertical Alignment : PRF_EX1.GSI				
	Chainage	**Element**	**Rad/Par**	**H**
1	0	Straight	0	31.100
2	27.918	EOP	0	31.654



Template: CRS_EX1.GSI

The horizontal alignment file specifies a template for each chainage. Our horizontal alignment file specifies only one template, "Tutor". You can, however, specify different templates for any chainage as you may require. We will define two templates, "Tutor" and "TypCut", in our template file.

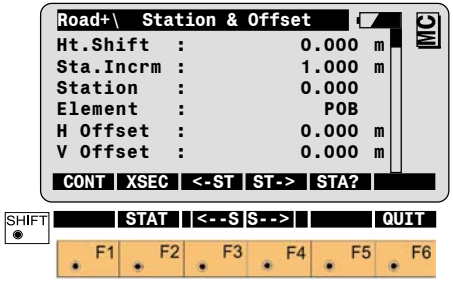
While running "ROADPLUS", you can switch templates at any time. ("TypCut" will not be used to stake out this example)

	Template	**Offset**	**Ht. Diff.**
1	Tutor	-35.000	-16.700
2	Tutor	-1.500	-0.030
3	Tutor	0.000	0.000
4	Tutor	1.500	-0.030
5	Tutor	35.000	-16.700
6	TypCut	-35.000	+16.630
7	TypCut	-1.500	-0.030
8	TypCut	0.000	0.000
9	TypCut	1.500	-0.030
10	TypCut	35.000	+16.630

2. **Copy the alignment and template files to your PCMCIA card.** Copy the files into the GSI subdirectory on your PCMCIA card. If the GSI subdirectory doesn't already exist on the PCMCIA card, you will need to create it. Place the PCMCIA card in your instrument.

3. **Set up the instrument in your work area and stakeout the example roadway.** Set the instrument coordinates to the values shown for point 1 (*see figure page 206*). Orient the instrument towards a convenient "North", and set Hz_o to zero (*see figure page 206*). Start "ROAD+" and continue reading this manual.

When the "Chainage & Offset" display first appears, only the lower portion beginning with "Station" will be visible. To view the entire display, use the green up/down arrow keys on the keyboard to scroll up to the top.



Ht. Shift
Vertical shift applied to the whole alignment. Set this to zero in this example.

Sta. Incrm.
The station (chainage) increment set in the configuration is displayed. If desired, a new value can be entered.

Station
Enter the station (chainage) to be staked.

Element
This displays the element for the chosen station (chainage) such as POB, PC, CURVE etc.

H. Offset
Horizontal offset to apply to the current chainage. Set this to -0.6 to stake the left side and 0.6 to stake the right side of the bikeway in this example.

V Offset
Additional vertical offset to apply to the current chainage.

F1 Press to stakeout the centerline point at the specified station (chainage). Depending on your program configuration, you may see the coordinates of this centerline point, or you may go directly to the STAKEOUT program.

F5 Allows you to take a measurement and determine the station (chainage) and offset of that measurement. You may then use the station (chainage) of that measurement to stake out a cross section point, if you desire.

F6 Press to change between cut and fill templates. "FillS" is shown when a cut template is active, "CutS" when a fill template is active.

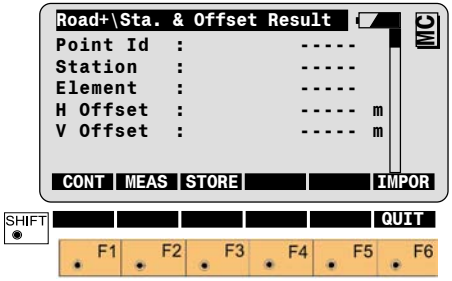
SHIFT F2 Allows you to view the active station equations, if you specified a station equation file when you started Road+.

SHIFT F3 Allows you to "jump" directly to the Begin Station (Chainage) specified in the configuration.

SHIFT F4 Allows you to "jump" directly to the End Station (Chainage) specified in the configuration.

SHIFT F5 Allows you to place a note in the Log File, if one is activated in the configuration.

From this dialog, you may make a measurement and Road+ will calculate the station (chainage) and offset at the prism, or you may import a point and calculate the station (chainage) and offset of that point.



F1 to set the measured point into the Station & Offset dialog. (Not available until after a measurement has been made, or a point imported.)

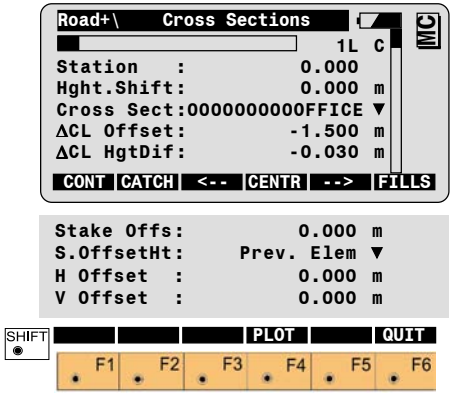
F2 to make a measurement. The normal measurement dialog is displayed. Press F4 when you are ready to calculate the station (chainage) and offset of a measured point. You will return to this dialog and see the Station, Element and Horizontal and Vertical offsets to the measured point.

F3 to store the results of this measurement. (Not available until after a measurement has been made.

F6 to import a point from a file, and use it to compute the station (chainage) and offset.

The first step in the procedure is to select a point on the cross section to be staked and enter the offset.

F2 Access the cross section options.



1L
Indicates the location of the cross section point in relation to the centerline. In this example, the "1L" means the first point of the template left of centerline.

C
Indicates that a cut template is active. An F would indicate that a fill template is active.

Chainage
Displays the current chainage.

Hght. Shift
Displays the vertical shift, if any, applied to the whole alignment.

Template
Displays the template name being used.

ΔCL Offset
Displays the horizontal distance of the template point from centerline (– for left)

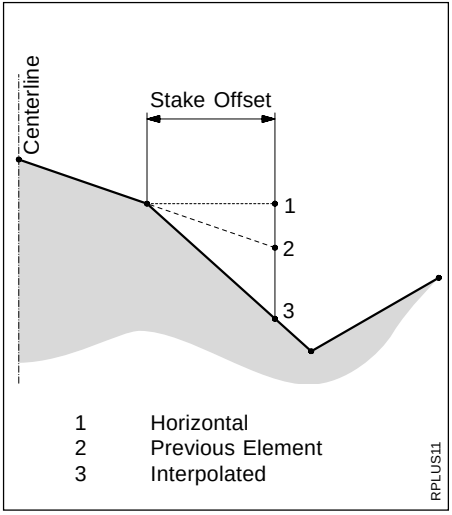
ΔCL Hgt Diff
Displays the difference in elevation of the template point between the centerline and the point to be staked.

Stake Offs.
This is the offset value that will be used for setting the offset stake. If the point is left of centerline, the value entered must be a negative number.

S. Offset Ht.
This display indicates the method used in computing the elevation of the point to be staked. The three methods are "Previous Element", "Interpolated" and "Horizontal".

Offset
Horizontal offset to apply to current chainage.

Ht. Offset
Additonal vertical offset to apply to current chainage.



F2 Activates the slope staking options

F3 Move along the current cross section from right to left.

F4 Sets the cross section point to the centerline

F5 Move across the current cross section from left to right

SHIFT F4 Displays a plot of the template.

The first point we want to stake for the bike path is the left edge of pavement. This point is 1.5 m left of centerline so the "ΔCL Offset" value should be set to a -1.5 m.

F3 Change the location to -1.5 m. The "ΔCL Ht. Diff" value will automatically change to the correct vertical difference based upon the design of the template.

The stake offset value needs to be set to a -0.600 m. The negative value is used because the point to stake is left of centerline.

To accept the value press ↵ .

The final step in the process is to select the method to use for computing the elevation of the offset point to be staked. The "ROAD+" program provides three methods to choose from:

Horizontal
The elevation is computed horizontally to the catch point.

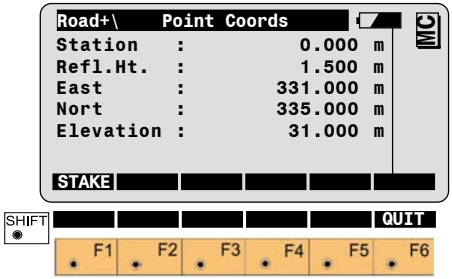
Previous Element
The elevation is computed on an extension of the grade of the previous element.

Interpolated
The elevation is interpolated to intersect the design slope of the cross section.

The most common method used is the "Horizontal" method.
To select this method, move the cursor to "S. Offset Ht" and press ↵ to display the three options.
Move the cursor to "Horizontal" and press ↵ .
This setting will remain as the current method until a different method is chosen. Therefore it is not necessary to go through the procedure every time.

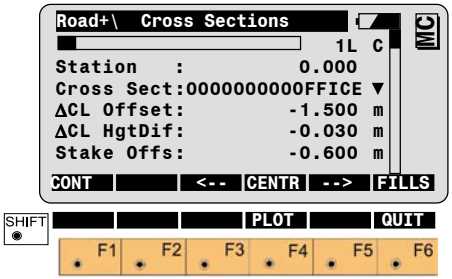
F1 Accepts and stores parameters set. Continues to display "Point Coords".

The "POINT COORDS" dialog displays the current chainage location of the offset point to be staked. The display also shows the value for the prism pole (Refl. Height) and the Easting and Northing coordinates of the offset point and the finished grade elevation of the actual point (not the offset location).



F1 Activates the stakeout program. (*See STAKEOUT*) Record the staked out point, or "CONT" in STAKEOUT to return to ROAD+.

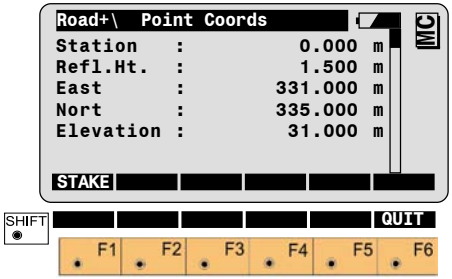
- **Stakeout Next point on Cross Section**



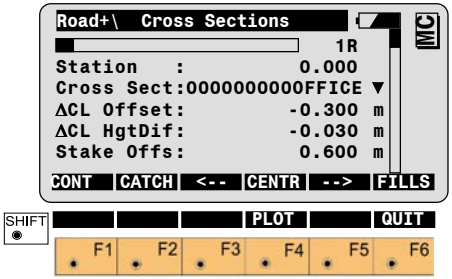
To set the offset stake for the right side of our example project:

F5 Set the "ΔCL Offset" value to positive 1.500 m.
Note when you do this the position changes from "1L" to "1R". Scroll down and highlight "Stake Offs.". Change the offset value to positive 0.600 m.

F1 Returns to the "POINT COORDS" display.

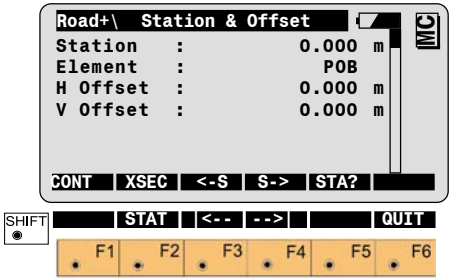


F1 Stakeout the 0.600 m offset stake for the right side of the bike path. (*See STAKEOUT*) Record the staked out point, or "CONT" in STAKEOUT to return to ROAD+.



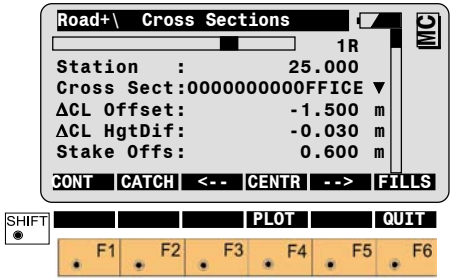
For this example, the last point staked was the 0.600 m offset point for the right side. When the "Cross Sections" display appears, the "ΔCL Offset" changes to the next point on the cross section. The next point to stake is the 0.600 m offset for the right side at the next station.

ESC Exits from the "Cross Sections" display and returns to the "Station & Offset".



F4 Moves to the next station (chainage) (you also may enter a new station (chainage)). The Station & Offset display will change to reflect the new station location.

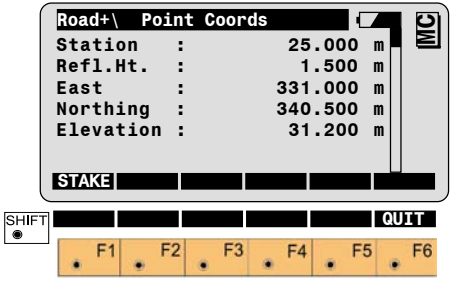
F2 Brings up the "Cross Sections" display.



In our example the last point staked was on the right side. Rather than have the rod person cross back over to the left side, it makes sense to stay on the right side and stake that position and then cross over to the left side.
To stake the catch point on the right side:

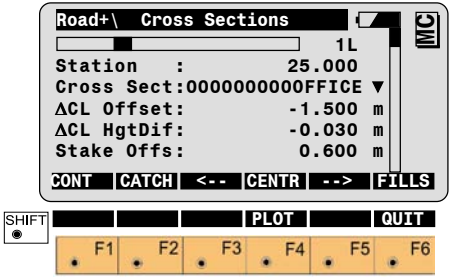
F5 Set the "ΔCL Offset" from centerline value to positive 1.500 m. The offset value should be positive 0.600 m, but should not require a change because that was the last offset value used for the previous right side point.

F1 Access the "Point Coords" display.



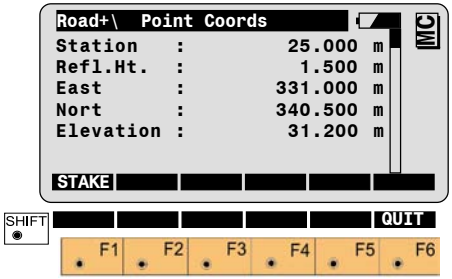
To stake the offset point on the right side for chainage 25+00:

F1 Activates the stakeout program.
Record the staked out point, or "CONT" in STAKEOUT to return to ROAD+.



F3 Change the "ΔCL Offset" from centerline to negative 1.5 m. Change the "Stake Offs." value to negative 0.600 m.

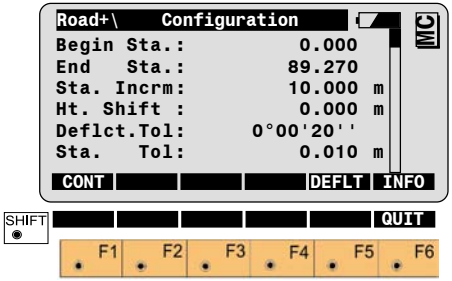
F1 Access the "Point Coords" display.



F1 Access the stakeout program. (*See STAKEOUT*)
Record the staked out point, or "CONT" in STAKEOUT to return to ROAD+.

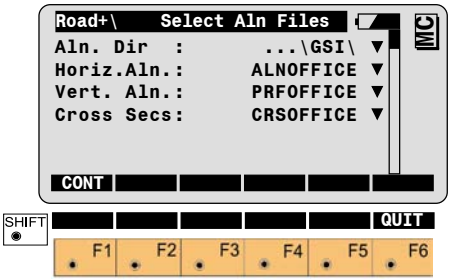
Start "ROAD+" from the program menu.

SHIFT F2 Start the "Configuration-Editor" from the "Select Aln Files" dialog.



Enter the beginning and ending station (chainage), the station (chainage) increment and so forth. Make all entries.

F1 Returns to the "Select Aln Files" display.

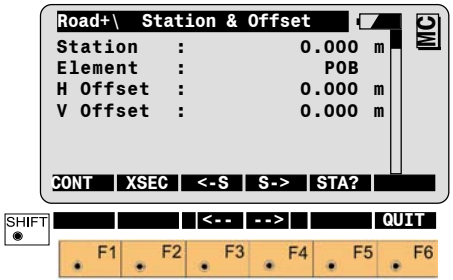


F6 Select the alignment files.

Place the cursor on each file type, press ↵ and pick the file from the displayed list. Select the files.

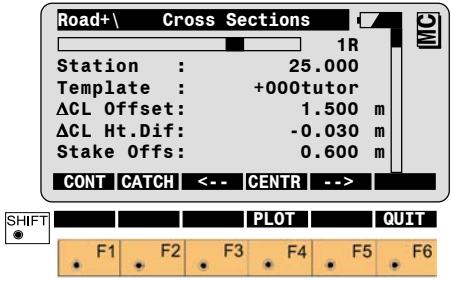
F1 To accept the specified files and check them for errors.

A Horizontal Alignment File must be selected.



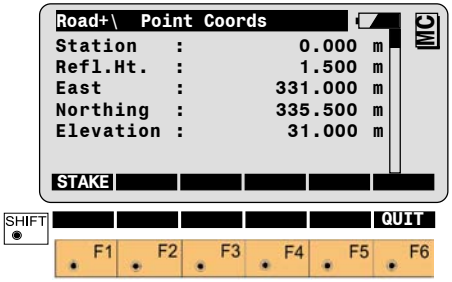
F2 To select the template point to stake (back of curb, edge of pavement etc.):

The "Cross Sections" options display appears.

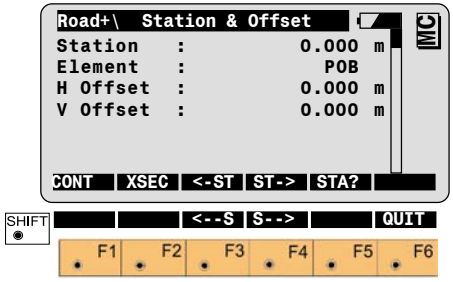


F3 or F5 Set the "ΔCL Offset" value. This value is the distance from centerline of the point you want to stake.
Move the cursor to "Template" and pick the cross section template to use, then set the "Stake Offs." (stake offset value). If the point is left of the centerline, enter the offset value as a negative value.

F1 Continues with display "Point Coords".



F1 The stakeout program will start with the polar stakeout method being used. (*See STAKEOUT*)
Record the staked out point, or "CONT" in STAKEOUT to return to ROAD+.

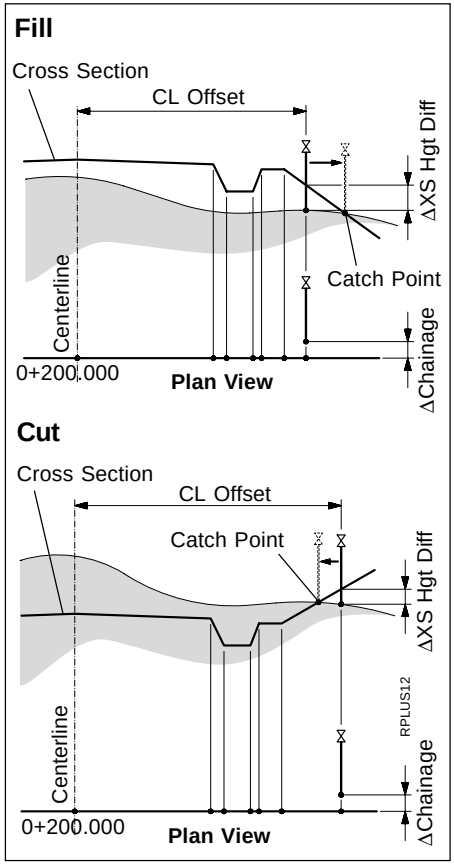


F3 or F4 Select a new station (chainage) (you also may enter a station (chainage).

F2 Select the point to stake out and the offset.
Repeat the procedure outlined in sections *"Set offset value and select point to stakeout"* through *"Select new chainage"*. Continue in this manner until all points have been staked.

Slope staking involves determining a point where the cross section template meets the ground surface. This Catch Point of zero cut/fill (Catch Point) is found primarily by trial and error and a lot of computing. The following diagram illustrates the concepts of slope staking.

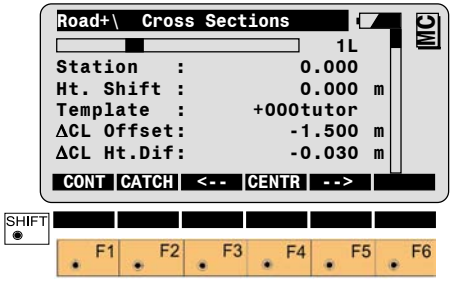
The slope staking routine is accessed from the "Cross Sections" display.



Set the "H + V Offsets" to zero.

F2 Start the "CROSS SECTIONS" display from the "CHAINAGE & OFFSET" display.

Set the "Ht. Shift" to zero.

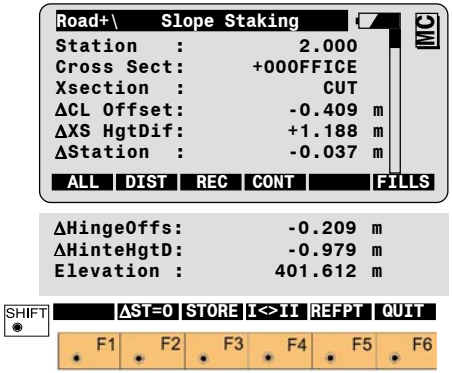


F3 or F5 Select the left- or right-most cross section point.

Before proceeding, move the cursor to the "Template" option.

Choose the template to use for slope staking. If the displayed template is the correct one, then it will not be necessary to change it.

F2 Start the slope stake program.



The "STORE" and "REFPT" options are not available until after a distance is measured.

F2 Measure to the current position of the prism pole. When the value of "ΔXS Hgt Diff" and "ΔStation" are zero, or close to it, the prism pole is at the catch point.

In the sample display shown, the value for "ΔXS Hgt Diff" is 1.188m. The value is positive, meaning the measurement was taken at a point that is above the cut slope. Assuming the cut slope is 1:1, the rodperson will want to move approximately 1 meter away from the centerline before making the next measurement.

The value of the ΔStation is -0.037m. The value is negative, meaning the measurement was taken at a point whose station is slightly lower than the indended 2.000. The rodperson will want to move slightly up station before making the next measurement.

In addition, the horizontal distance from centerline is displayed which is -0.409 m for this example.

After moving to a new location, measure a distance to the prism and view the results. When the "ΔXS Hgt Diff" and "ΔStation" are at or near zero the catch point has been located both vertically and horizontally for the chosen chainage.

F3 Record the staked out position.
The "SLOPE STAKING" display returns and another catch point can be staked.

F4 Exit the slope staking program.

- **SLOPE STAKING Menu Function Key Summary**

F1 Measures the distance to the target, and automatically records the data as defined by the currently set recording mask.

F2 Measures the distance only, and updates the display.

F3 Records the information for the current measurements.

SHIFT F2 Sets the station to the value of the last measurement.

The "ΔSt=0" function is not available until a distance is measured.

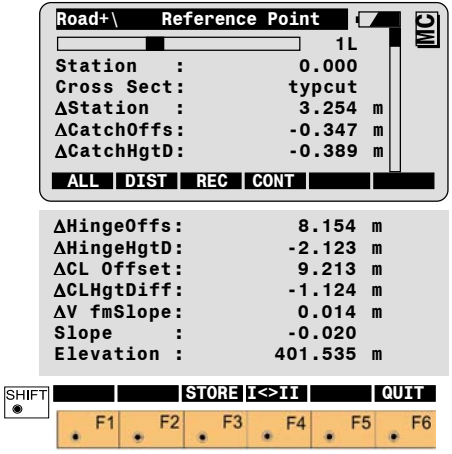
SHIFT F3 Stores the data to the log file.

The STORE function is not available until a distance is measured.

SHIFT F4 Switches between face one and face two for measurements.

SHIFT F5 After a measurement is made to the prism pole the "REFPT" option will be available. See section "Reference Point" for a detailed discussion of this option.

SHIFT F5 Displays additional information about how the location of the prism pole relates to components of the cross-section. Do this after a measurement at the catch point has been made.



1L
Indicates the location of the cross section point in relation to the centerline. In this example, the "1L" means the first point of the template left of centerline.

Station
Displays the currently specified station (chainage).

Cross Sect
Displays the currently specified template name.

ΔStation
Displays difference between the station (chainage) of the last measurement to the rod and the currently specified station (chainage). Move the rod toward the beginning of the project if this value is positive, move the rod away from the beginning of the project if this value is negative.

ΔCatch Offs
The horizontal offset from the catch point to the last measurement.

ΔCatch HgtD
The vertical offset from the catch point the last measurement.

ΔHinge Offs
The horizontal offset from the hinge to the last measurement.

ΔHinge HgtD
The vertical offset from the hinge to the last measurement.

ΔCL Offset
The horizontal offset from the centerline to the last measurement.

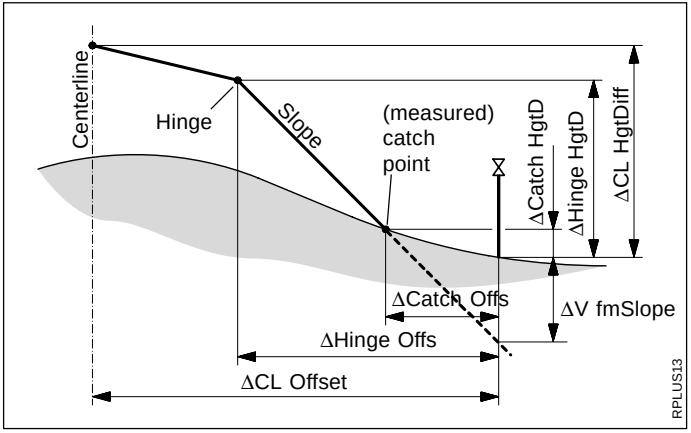
ΔCL HgtDiff
The vertical offset from the centerline to the last measurement.

ΔV fmSlope
Vertical distance from Cut- or Fill-slope at the specified station.

Slope
Slope ratio of Cut- or Fill slope.

Elevation
Elevation at measurement.

The following illustration represents the various components of the REFPT option.



The following describes the format and contents of the data stored for alignments and cross-sections in the Road+ program. All files are in GSI format and all files for a project must be located in the same directory of the memory card.

The following geometric elements are supported:

Element	Definition	Declaration in the alignment file
Tangent	Station, Beginning (X,Y)	"STRAIGHT"
Circular curve	Station, Beginning of arc (X,Y), Radius,	"000CURVE"
Spiral in	Station, Beginning of curve (X,Y), A-Parameter (A= $\sqrt{LxR}$)	"00SPIRIN"
Spiral out	Station, Beginning of curve (X,Y), A-Parameter (A= $\sqrt{LxR}$)	"0SPIROUT"
Curve in	Station, Beginning of curve (X,Y), Radius 1, Radius 2	"0CURVEIN"
Curve out	Station, Beginning of curve (X,Y), Radius 1, Radius 2	"CURVEOUT"
End of Project	Station, Coordinates (X,Y)	"00000EOP"

Header of the Horizontal Alignment File:

```
41....+000JOBID 42....+HZALIGNM 43......+STACOORD
```

WI 41 Job-Identification. Max. 8 ASCII-characters, may be defined by user.
WI 42 Identification of Horizontal Alignment file. May not be changed by user.
WI 43 Identification of principal point type file. May not be changed by user.

The data block for a principal point in the file is structured as follows :

```
11....+KILOMETR 71....+0NEXTGEO 72....+0NEXTRAD
73....+0TEMPLNR 81..10+00000000 82..10+00000000
```

WI 11 Station (chainage) of the point.
WI 71 Type of the following geometric element.
WI 72 Radius of the next horizontal geometric element, Radius 1 for a compound curve, or the A-Parameter for spirals.
WI 73 Number of a cross-section (Template) assigned to the next geometric element.
WI 74 Radius 2 for compound curves.
WI 81 E-Coordinate of the point.
WI 82 N-Coordinate of the point.

Comments:

- The header consists of a single block at the start of a data file.
- Tangents and the EOP contain “00000NON” in WI72
- Data units and decimal places in WI’s 11, 72 and 74 are defined by WI81 and WI82.
- If the radius point for a curve (circular or spiral) is to the left of the alignment (looking in the direction of increasing stations) the radius is negative.
- If the radius point for a curve (circular or spiral) is to the right of the alignment (looking in the direction of increasing stations) the radius is positive.
- A cross section (Template) may be assigned to more than one location.

- An alignment file must contain at least two elements. The last element must be "EOP".
- There is no limitation on the size of the Hz-alignment file. If a file is created/edited using the program "ROAD+FILE EDITOR" on the TPS1100, there is a limitation of 200 data blocks.

Example of a Horizontal Alignment:

```
41....+0EXAMPLE 42....+HZALIGNM 43....+STACOORD
11....+00000000 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06000000 82..10+02000000
11....+00198832 71....+00SPIRIN 72....-00122474
73....+QP000123 81..10+06068005 82..10+02186841
11....+00348832 71....+000CURVE 72....-00100000
73....+QP000123 81..10+06150344 82..10+02307751
11....+00450725 71....+0SPIROUT 72....-00100000
73....+QP000123 81..10+06247816 82..10+02304071
11....+00550725 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06310759 82..10+02227794
11....+00714138 71....+00SPIRIN 72....+00054772
73....+QP000124 81..10+06392465 82..10+02086275
11....+00789138 71....+000CURVE 72....+00040000
73....+QP000124 81..10+06445859 82..10+02037807
11....+00824376 71....+0SPIROUT 72....+00044721
73....+QP000124 81..10+06478120 82..10+02048886
11....+00874376 71....+STRAIGHT 72....+00000NON
73....+QP000125 81..10+06496445 82..10+02094478
11....+01127904 71....+00000EOP 72....+00000NON
73....+QP000125 81..10+06540469 82..10+02344154
```

The principal points method allows joining elements without the use of intermediate tangents.
The following combinations, for example, may be defined:

- **Double spiral: spiral out followed by spiral in**
- **Multiple circular curves**
- **S curves with and without intermediate tangents**

Geometric elements supported:

Element	Definition	Declaration in the alignment file
Tangent	Station, H	"STRAIGHT"
Circular curve	Station, Radius, H	"000CURVE"
Parabola	Station, Parabola parameter, H (see page 192 for Parameter Formulare)	"0PARABOL"
End of Project	Station, H	"00000EOP"

Vertical Alignment File Header:

```
41....+000JOBID 42....+0VALIGNM 43......+STACOORD
```

WI 41 Job-Identification. Max. 8 ASCII-characters, may be defined by user.
WI 42 Identification of Vertical Alignment file. May not be changed by user.
WI 43 Identification of principal point type file. May not be changed by user.

Example for a data block for a vertical alignment point:

```
11...+KILOMETR 71...+ONEXTGEO 72...+ONEXTRAD 83..10+00000000
```

WI 11	Station (chainage) of a vertical alignment point
WI 71	Type of the following geometric element
WI 72	Radius of the following geometric element or parabola parameter
WI 83	Elevation of the point

Comments:

- The header consists of a single block.
- Tangents and the EOP contain “00000NON” in WI72
- Data units and decimal places in WI’s 11 and 72 are defined by WI83.
- Tangent and arc lengths are calculated from the stationing.
- The stationing is projected onto a horizontal plane.
- If the curve radius point lies above the centerline, the radius is positive.
- If the curve radius lies beneath the centerline, the radius is negative.
- An alignment file must contain at least two elements.

Example of a vertical alignment file:

```
41....+0example 42....+0VALIGNM 43....+STACOORD
11....+00000000 71....+STRAIGHT 72....+00000NON 83..10+00400000
11....+00300000 71....+0PARABOL 72....-01142932 83..10+00422500
11....+00500000 71....+STRAIGHT 72....+00000NON 83..10+00420000
11....+00550000 71....+0PARABOL 72....+02091126 83..10+00415000
11....+00850000 71....+STRAIGHT 72....+00000NON 83..10+00406522
11....+01127904 71....+00000EOP 72....+00000NON 83..10+00418605
```

Geometric elements supported:

Element	Definition
Height differences	Height difference from the centerline
Distance	Horizontal distance from the centerline
Cross section type	Differentiate between CUT and FILL cross sections
Slope	Slope ratio

Header of the Cross Section File:

```
41....+00JOB_ID 42....+TEMPLATE
```

WI 41 Job identification. Max. 8 ASCII characters, user definable.
WI 42 Template file identification. May not be changed by user.

A data block for a cross section is structured as follows:

```
11....+0PROF_NR 35..10+DISTANCE 36..10+000HDIFF
71....+0000FILL 72....+00002000
```

WI 11 The cross section number.
WI 35 Horizontal distance from the centerline.
WI 36 Height difference from the centerline.
WI 71 Cross section type.
WI 72 Slope ratio.

Comments:

- All data blocks having the same cross section number (WI11) belong together.
- All data blocks belonging to a cross section must be consecutive in the file to minimize file access.
- The data blocks for a cross section must be sorted from left to right across the section.
- Data units defined by WI 35+36.
- Cross-sections do not have to be sorted by number.
- A negative distance (WI35) indicates a point to the left of the centerline.
- A positive distance (WI35) indicates a point to the right of the centerline.
- A negative height difference (WI36) indicates a point below the centerline.
- A positive height difference indicates a point above the centerline.
- A cross-section may contain up to 48 points.
- A template file must contain at least one cross-section.
- The entries for cross section type and slope are optional.
- The non-zero slope entry must be attached only to the last point on each side of the cross section.

Example:

```
41....+0EXAMPLE 42....+TEMPLATE
11....+QP000123 35..10-00013000 36..10-00003000
11....+QP000123 35..10-00010000 36..10-00005000
11....+QP000123 35..10-00004000 36..10-00000100
11....+QP000123 35..10+00004000 36..10+00000100
11....+QP000123 35..10+00010000 36..10-00006000
11....+QP000123 35..10+00013000 36..10-00003500
11....+QP000124 35..10-00012000 36..10-00002000
11....+QP000124 35..10-00011000 36..10-00004000
11....+QP000124 35..10-00004000 36..10+00000100
11....+QP000124 35..10+00004000 36..10-00000100
11....+QP000124 35..10+00011000 36..10-00005000
11....+QP000124 35..10+00012000 36..10-00002500
11....+QP000125 35..10-00012000 36..10-00002000
11....+QP000125 35..10-00011000 36..10-00002500
11....+QP000125 35..10-00004000 36..10-00000070
11....+QP000125 35..10+00004000 36..10-00000070
11....+QP000125 35..10+00011000 36..10-00002500
11....+QP000125 35..10+00012000 36..10-00002000
11....+TEMPLATE 35..41-00002000 36..11+00000000 71....+0000FILL
72....+00002000
11....+TEMPLATE 35..41-00000500 36..11+00000000 71....+0000FILL
72....+00000000
11....+TEMPLATE 35..41+00000000 36..11+00000000 71....+0000FILL
72....+00000000
11....+TEMPLATE 35..41+00001000 36..11+00000000 71....+0000FILL
72....+00000000
11....+TEMPLATE 35..41+00002000 36..11+00000000 71....+0000FILL
72....+00002000
```

Elements supported:

Element	Definition
Cross Section number	The number or identifier of the cross section
Chainage	The chainage from which the cross section is applied

Header of the Cross Section Assignment File:

```
410001+000ASKER 42..10+ASSIGNMT 43....+CRSASKER
```

WI41 Job identification. Max. 8 ASCII characters, user definable.
WI42 Cross section assignment file identification. May not be changed by user. Data units are defined by characters 6+7 of WI42.
WI43 Name of the corresponding cross section file.

A data block for a cross section assignment is structured as follows:

```
110002+0000NORM 71....+00382000
```

WI 11 The cross section number or identifier
WI 71 Beginning chainage for that cross section

Comments:

- A cross section assignment file must have a corresponding cross section file.
- A cross section remains valid until a new cross section is assigned.
- A given cross section may be assigned more than once.
- The units for station (chainage) are defined in WI 42 in the file header.

Example:

```
410001+000asker 42..10+ASSIGNMT 43....+CRSASKER
110002+0000NORM 71....+00382000
110003+0000NORM 71....+00552000
110004+00000568 71....+00568000
110005+000568.1 71....+00568100
110006+000585.1 71....+00585100
110007+000585.2 71....+00585200
110008+0000NORM 71....+00611000
110009+0000NORM 71....+00775000
110010+00000811 71....+00811000
110011+000826.9 71....+00826900
110012+00000827 71....+00827000
110013+00000827 71....+00844000
110014+000826.9 71....+00844100
110015+00000860 71....+00860000
```

Elements supported:

Element	Definition
Station equation number	The number or identifier of the station equation
Chainage ahead	The chainage to be applied going forward along the alignment from the equation.
Chainage back	The chainage to be applied going backward along the alignment from the equation.

Comments:
Data units are defined by characters 6+7 in WI42+43

Header of Station Equation File:

```
41....+00JOB_ID 42....+0STAEQTN
```

WI41 Job identification. Max. 8 ASCII characters, user definable.
WI42 Station Equation file identification. May not be changed by user.

A data block for a station equation is structured as follows:

```
41....+00000001 42..10+00100000 43..10+00200000
```

WI 41 The station equation number.
WI 42 Chainage ahead.
WI 43 Chainage back.

Example:

```
41....+00JOB_ID 42....+0STAEQTN
41....+00000001 42..10+00100000 43..10+00200000
41....+00000002 42..10+00566000 43..10+00600000
```


If "Log File" is set to "ON" the measurements and the results are stored in the ASCII-file specified within the "Configuration Editor". This file is created in the directory LOG on the memory card. Subsequently, you can read the memory card on your PC and obtain a hard copy of the Log-file.

Data will always be appended to the specified Log-file.

The Log-file contains the following information:

Header includes:

- the program used,
- information about the instrument,
- the file to store the measurement data,
- the date and the time.

Configuration

the name of the input files for:
- the Hz-alignment,
- the V-alignment and
- the cross section.

Measurement

- Instrument station with coordinates and instrument height.
- Stakeout point with heigth offset,
- offset[1] and height displacement[2] relative to centre line,
- comparison values from planning, and associated differences.

[1] This value results from
- the displacement of the zero point of the profile

and
- the displacement taken from the transverse profile.

[2] This value results from
- the displacement of the zero point of the profile

and
- the displacement taken from the transverse profile
- the height displacement in the configuration.

Example of a log file for the program "Road+":

```
Leica Geosystems  VIP RoadPlus V 0.90
Instrument        :    TPS1100, Serial 400001,
Meas. File        :    FILE01.GSI
Program Start     :    02/07/1998 at 10:37

Horizontal Aln    :    ALNSPORT.GSI
Vertical Aln      :    PRFSPORT.GSI
Cross Sections    :    CRSSPORT.GSI

Station no.       :    1
                       E= 0.000m      N= 0.000m    ELV= 0.000m       hi= 1.6000m

Point No.         :    55
Chainage          :    150.000, Offset=  0.000m,              Hght Offset= 0.000m
Design            :    E= -79.269m,      N=   19.917m,        ELV= 400.501m
Staked            :    E= -1.057m,       N=  2.578m,          ELV=   0.107m
Deltas            :    dE= -78.211m,     dN=  17.339m,        dELV= 400.394m

Point No.         :    5
Chainage          :    100.000, Offset=   0.000m,             Hght Offset= 0.000m
Design            :    E= -46.305m,      N=   26.708m,        ELV=    400.409m
Staked            :    E=  -0.000m,      N=   2.774m,         ELV=     0.051m
Deltas            :    dE= -46.305m,     dN= 23.934m,         dELV=   400.358m

Point No.         :    5
Chainage          :    100.785, Offset=      0.000m,          Hght Offset= 0.000m
Design            :    E= -46.688m,      N=  27.392m,         ELV=  400.365m
Staked            :    E= -0.000m,       N=  2.774m,          ELV=   0.051m
Deltas            :    dE= -46.688m,     dN= 24.619m,         dELV= 400.314m
```

Introduction

This manual describes the "AUTO RECORD" program of the TPS1100 instruments.

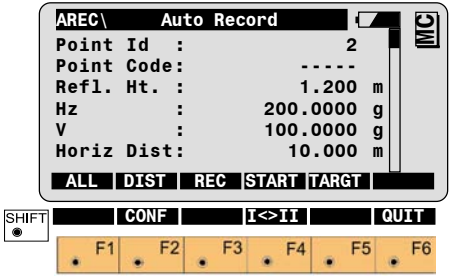
The program automates the recording of field measurement data and is designed especially for TPS1100 instruments with ATR. The program does not require the use of a 360° prism, but the 360° prism does facilitate the field work by avoiding the need to keep the prism oriented toward the TPS1100 instrument. Once the program configuration has been set in accordance with the requirements of the particular survey being performed, and tracking mode measurements started, positions will be automatically measured and recorded with no further operator input.

Feature coding may be added to the recorded data as necessary, while the program continues to operate. It is not necessary to exit the program in order to input and record feature coding information.

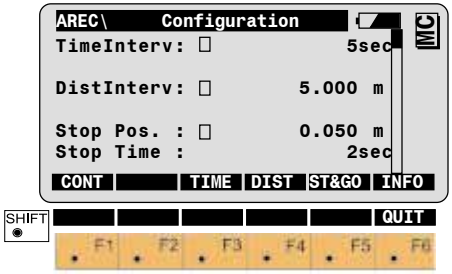
Automatic recording may be triggered by the current distance from the last recorded position, the time elapsed since the last recorded position, the prism remaining stationary for a specified length of time, or any combination of the above factors. When a combination of factors is specified, a position is recorded as soon as any one of the factors is satisfied. At any time, a position may be recorded manually by pressing a single button. Whenever a position is recorded, manually or automatically, all currently active factors are "reset" and begin counting anew for the next automatically recorded position.

Configuration Options

Before using the Auto Record program the first time, you must select the mode or modes and define the interval or intervals you wish to use to control the automatic recording process.
When you start the program, the AREC\ MEASUREMENT dialog will be displayed.



SHIFT F2 To access the AREC\ CONFIGURATION dialog.



Three automatic recording modes are available:

- Time Interval,
- Distance Interval and
- Stable Position.

The intervals are applied relative to the last recorded position, whether triggered manually or automatically. In all cases, the measurement data will be recorded using the REC Mask you have specified.

TimeInterv
When this mode is ON and the TCA-/TCRA-instrument is following a prism in the tracking measurement mode, measurement data will be recorded automatically whenever the time since the last recorded measurement data exceeds the time interval shown here, i.e. every 5 seconds.

DistInterv
When this mode is ON and the TCA-/TCRA-instrument is following a prism in the tracking measurement mode, measurement data will be recorded automatically whenever the three dimensional slope distance from the last recorded measurement data exceeds the distance shown here, i.e. 5 meters.

Stable Pos, StableTime
When this mode is ON and the TCA-/TCRA-instrument is following a prism in the tracking measurement mode, measurement data will be recorded automatically whenever the prism remains within a circle of the radius for the length of time shown here, i.e. the position remains constant within 5 centimeters for 2 seconds.

F1 Continue to the AREC\ MEASUREMENT dialog after selecting and/or setting the automatic recording mode(s) as necessary.

F3 Toggle the Time Interval mode ON or OFF. When this mode is OFF, the small square next to TimeInterv: will be empty and the time interval definition will be a series of dashes. When this mode is ON, there will be a small X in the square, and the last active time interval will be shown.

F4 Toggle the Distance Interval mode ON or OFF. When this mode is OFF, the small square next to DistInterv: will be empty and the distance interval definition will be a series of dashes. When this mode is ON, there will be a small X in the square, and the last active distance interval will be shown.

F5 Toggle the Stable Position mode ON or OFF. When this mode is OFF, the small square next to Stable Pos: will be empty, and both the stable position and stable time definitions will be a series of dashes. When this mode is ON, there will be a small X in the square, and the last active stable position and stable time definitions will be shown.

F6 Display the Auto Record Information screen.

SHIFT F6 Quit the Auto Record program without recording any more data.

You may have any combination of automatic recording modes active at the same time, or all of them if you find it advantageous. When more than one mode is active simultaneously, the first mode that is satisfied causes the position of the prism to be recorded and then resets all of the active modes.

For example:

- Suppose you have both the Distance Interval and Stable Position modes ON, the TCA-/ TCRA-instrument is following a prism in the tracking measurement mode, and the last recorded measurement data was at X = 10, Y = 10.

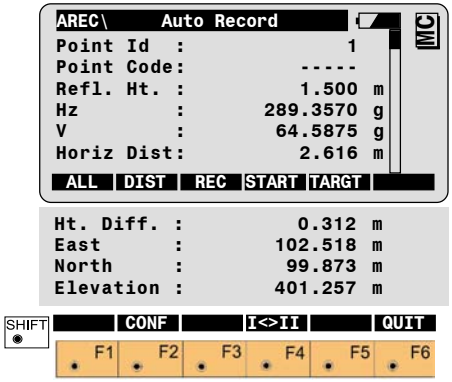
As long as the prism is moving continuously but never gets more than 5 meters from XY = 10, no more data will be recorded. If you stop and center the prism over a point of interest, say at X = 12, Y = 12, for 2 seconds, that measurement data will be automatically recorded and will reset the distance interval as well. Then, as long as the prism is moving continuously but never gets more than 5 meters from XY = 12, no more measurement data will be automatically recorded.

- If you move directly North from XY = 12, more measurement data will be automatically recorded as you move past X = 12, Y = 17. The exact measurement data to be recorded will depend upon how rapidly you are moving and how close to the 5 meter limit the preceding measured position was.

- If you continue moving directly North from X = 12, Y = 17 and press REC to trigger a manual position recording as you pass X = 12, Y = 20, that will reset the distance interval as well. Then, as long as the prism is moving continuously but never gets more than 5 meters from X = 12, Y = 20, no more measurement data will be automatically recorded.

This combination of Distance Interval and Stable Position modes is ideal for automating a topographic survey of an irregularly detailed site. In relatively open areas, measurement data will be automatically recorded as the prism is "scanned" across the surface, based on the specified distance interval. In areas with more detail, measurement data will be automatically recorded whenever the prism is centered over a point of interest for the indicated amount of time.

When the program starts, it will display the AREC\ MEASUREMENT dialog.



Point Id
The point identifier assigned to the next recorded position.

Point Code
The Point Code assigned to the next recorded position. The Point Code may or may not be recorded, depending on the REC Mask you have specified.

Refl. Ht.
The current height of the prism above the end of the plumb pole, or above the ground if the prism is mounted on a vehicle or other objects.

Hz
The current reading of the horizontal circle. This will correspond with the grid azimuth of the line of sight only if the instrument has been oriented before starting the Auto Record program.

V
The current reading of the vertical circle.

Horiz.Dist
The last unrecorded slope distance reduced to a horizontal distance at the elevation of the instrument.

Ht. Diff.
The ground to ground height difference from the instrument station to the prism at the last measured slope distance.

East
The Easting or X coordinate at the last measured slope distance to the prism.

North
The Northing or Y coordinate at the last measured slope distance to the prism.

Elevation
The ground elevation at the last measured slope distance to the prism.

F1 Manually trigger the measurement of a single distance and record the measurement data in the active Measure Job. The distance-related results will not be displayed. The data will be recorded using the REC Mask you have specified.

F2 Manually trigger the measurement of a single distance. The distance-related results will be displayed and may be viewed by scrolling the display.

F3 Manually record the currently displayed data, with or without any distance-related data, in the active Measure Job. May be pressed at any time during the automatic data recording process to record the current position of the prism in the active Measure Job. The data will be recorded using the REC Mask you have specified.

F4 Start the automatic data recording process. ATR will be turned on, if it is not already on, and the EDM will start measuring in the rapid tracking mode. Whenever an automatic recording mode is satisfied, a position will be automatically recorded in the active Measure Job. The data will be recorded using the REC Mask you have specified.

F5 If this function is available on this dialog in your current instrument configuration, use it to set the prism offset and ppms to match the conditions that exist when you are measuring.

SHIFT F2 Access the Auto Record Configuration dialog to select and/or change the automatic recording mode and interval in use.

SHIFT F4 Change the instrument face from I to II (Motorized instruments only.)

SHIFT F6 Quit Auto Record without recording any more data.

CODE Call up the CODE function to create and record a Code Block in the active Measure Job.

The Auto Record program works with the TPS1100 series TCA instruments to automate the collection of large quantities of measurement data for topographic surveys. It can be used to great advantage on larger, open sites when the prism is mounted on a vehicle, and the vehicle is then driven on a suitable weaving pattern to cover the area of the site. Measurement data will be recorded along the path of the vehicle, on virtually any useful spacing. Auto Record can also be used to speed the process of collecting data for detailed topographic surveys, as-built surveys and any other type of survey where large numbers of features must be located.

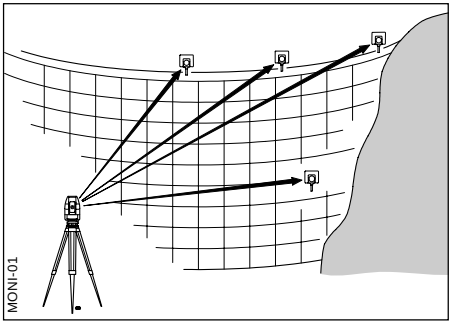
Auto Record does not interfere with the use of Coding to identify the measurements being recorded.

Remote Control Surveying (RCS) also works well with Auto Record, making it especially easy to perform detailed topographic surveys with a one man survey crew.

Auto Record does not generate a logfile.

Introduction

This manual describes the "Monitoring" program for the TPS1100 Professional series instruments.
The program is used for repeated automatic measurements. It measures angles and distances to predefined points.
The location of the points can be "learned" by measuring to them in the "Learning Points" dialog or point information can be taken from a *.GSI file stored on the PCMCIA card.



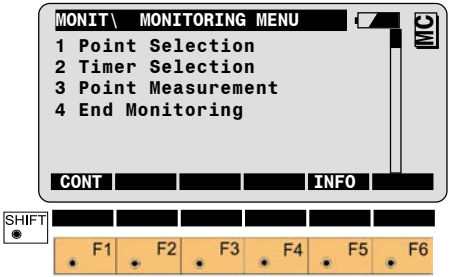
Max. 50 points and as many repetitions as desired, at any time intervals.

With the timer function the program can trigger automatic measurements at any predefined interval.

The measurements can be:
- repeated as often as is necessary,
- at any time
- performed in both faces.

The point number, the horizontal and vertical angles and the slope distance for the individual measurements are stored on the memory card.

Points to be measured must be permanently equipped with Leica Geosystems prisms.
The instrument must be firmly mounted on a tripod or pillar.
Measurements are limited only by the storage capacity of the PCMCIA memory card.



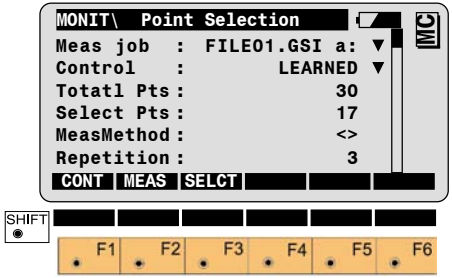
1 Selection of points to be measured.

2 Set timer requirements.

3 Start point measurement.

4 Exit the "Monitoring" program.

The points and the measurement method to be used can be selected in this menu.



Meas job:
Select the measurement job to record measured data to.

Control:
The points to be used during the measurement can be "learned" or taken from a previously stored data file by selecting either 'Learned' or a '*.GSI' file.

Total Pts:
Total number of learned or recorded points.

Select Pts:
Number of points selected for measurements.

MeasMethod:
There are 4 measurement methods to choose from.

<> Measures all repetitions in face I followed immediately by all repetitions in face II at each point. Instrument stays in closest face, i.e. if last face at point A is face II then first face at point B is face II.

[A I	A II	B II	B I	C I	...]
[1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	...]

>< Measures loops of all points in face I followed by all points in face II in the inverse sequence of points. Number of loops equals the number of repetitions.

```
[1: I      II      2: I      II      3: I      ...]
[  A B C  C B A     A B C  C B A     A B C  ...]
```

>> Measures a set of all points in face I followed by all points in face II in the same point order. Number of sets equals number of repetitions.

```
[1: I      II      2: I      II      3: I      ...]
[  A B C  A B C     A B C  A B C     A B C  ...]
```

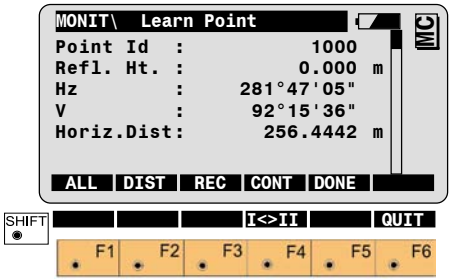
> Measures all repetitions to each point before moving to next point. Only in face I.

```
[A I     B I     C I     ...]
[1,2,3   1,2,3   1,2,3   ...]
```

F1 Go to Main menu after all points have been activated and MeasMethod selected.

F2 Calls the Measurement menu for first time point measurement *(See measurement menu).*

F3 Calls the Point Selection (*See Selecting the Points to be Measured).*



If the measurement file already contains points, then when this function is called you will be asked whether the points are to be overwritten.

For the instrument to learn a point the prism must be targeted manually. Triggering the distance measurement then initiates a distance measurement and a precise determination of the angle.

F1 Simultaneously measure and record data in the active measurement job.
Measured point becomes selectable.

F2 Measure a distance.

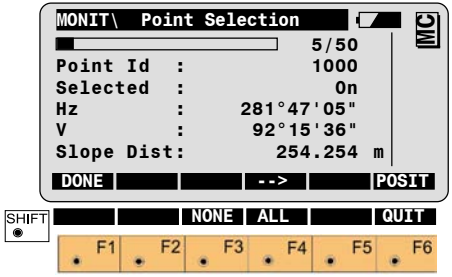
F3 Record the measurement in the active measurement job.
Measured point becomes selectable.

F4 Accept the measurement.
Measured point becomes selectable.

F5 Quit the function after all points have been measured; return to the "Point Selection" menu.

Selecting the points to be measured

Select the points required for the automatic measurement here.
Identical point numbers can be used for different points.



Selected:
On/Off activates and deactivates current point.

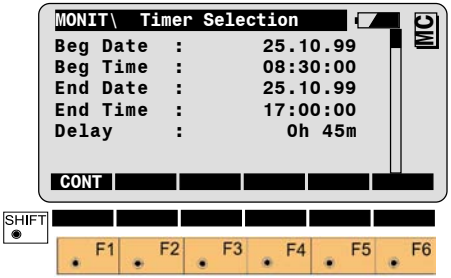
F1 Ends Point Selection and returns to previous dialog.

F4 Display the next point in the file.

F6 Positions telescope to displayed target.

SHIFT F3 Deactivate all points.

SHIFT F4 Activate all points.

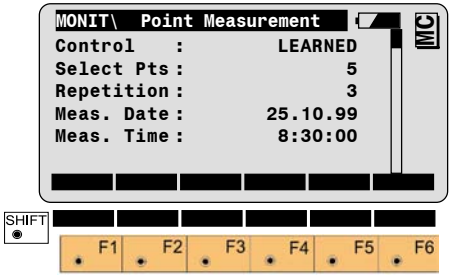


Beg/End Date/Time:
Enter beginning date and time as well as end date and time. End time must be later than beginning time and current time for measurements to start.

Delay:
A delay of up to 99 hours and 59 minutes can be set. Delay is from beginning to beginning, i.e. if a complete measurement with all repetitions takes 30 minutes and delay is set to 45 min, there will be a 15 min. pause after the end of the measurements before the instrument starts to measure again. If Delay is shorter than measurement time, instrument measures continuously.

F1 Go back to Main Menu after completing all settings.

Dialog shows date and time of next measurement.



If a point can not be measured, the TCA or TCRA starts its internal search routine and, if unsuccessful, goes on to the next point to be measured.

ESC Abort the automatic measurement.

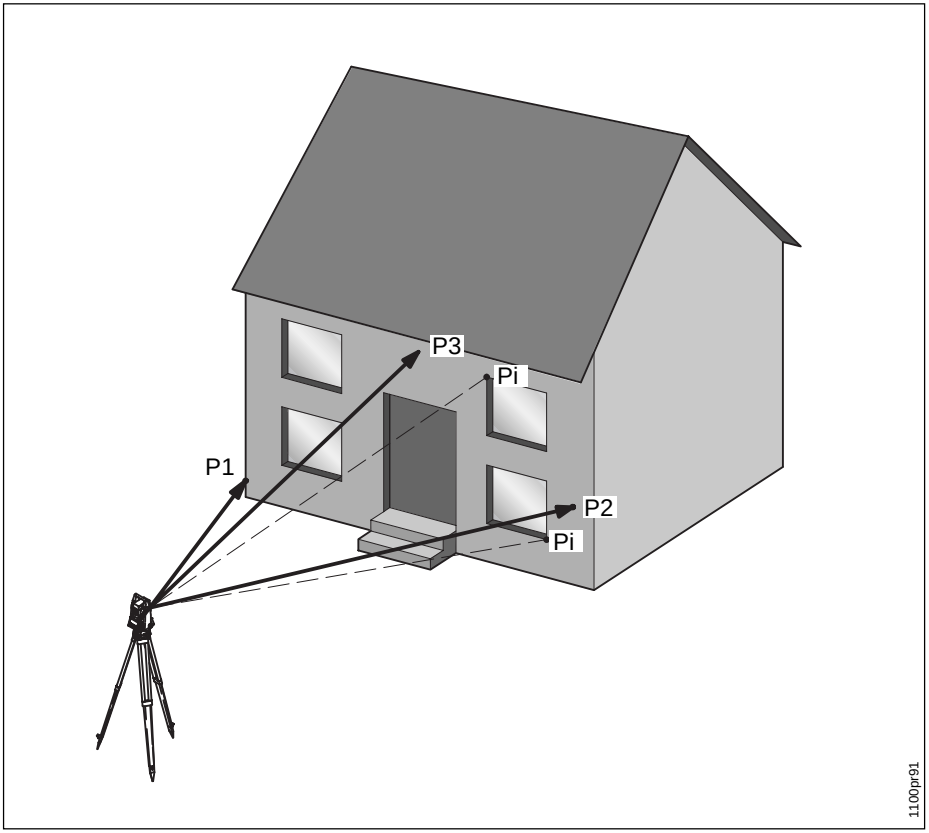
Introduction

This manual describes the program "Reference Plane" for TPS1100 Professional series instruments.

Reference Plane first defines a reference plane and then calculates coordinates of points on the plane from Hz- and V- angles. If distances are measured, the perpendicular deviation of the point from the plane is also calculated.

The plane can be defined in the instrument coordinate system or in a "local" plane coordinate system.

Two points can be used to define a vertical plane or 3-10 points can define a tilted plane. With 4 or more points, a least squares adjustment is calculated resulting in an adjusted plane.



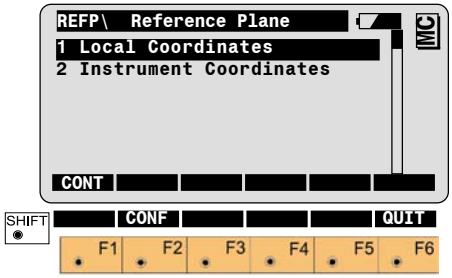
The max. allowed deviation of these points from the plane can be set in the Configuration dialog.

Once the plane has been defined it can be shifted by an entered offset. Alternatively it can be shifted through a measured point.

Plane information as well as measured points can be recorded in a Logfile.

Reference Plane Menu

The coordinate system is selected in the beginning.



Local Coordinates
After measuring the points to define the plane the user can enter local coordinates for the first point. This sets the local coordinate system. All points are calculated in it.

Instrument Coordinates
All points are calculated and recorded in the instrument coordinate system.

For Instrument Coordiantes station must be setup and oriented.

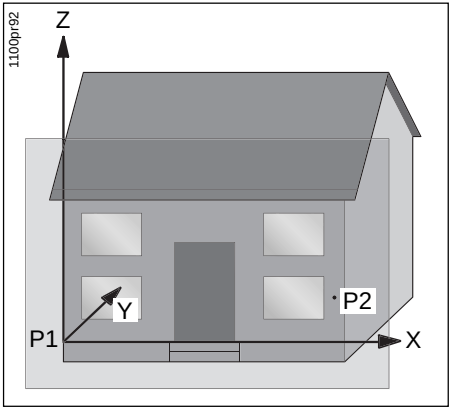
Vertical Plane

A vertical plane is defined by 2 points.

The X-axis of the plane starts in the first measured point and points to the right (seen from the instrument station). It is horizontal.

The Z-axis is parallel to the instrument zenith.

The Y-axis is perpendicular to the plane. Offsets are applied in the direction of the Y-axis.

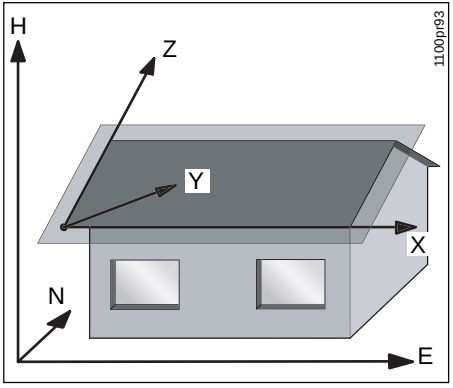


For **horizontal planes** the positive Z-axis points in the direction of the instrument's zenith. X- and Y-axes are horizontal.

Tilted Plane

For "local" planes defined by 3 or more points the Z-axis is defined by the steepest grade of the plane.

The Y-axis is the normal vector of the plane (+Y is away from the instrument) and the X-axis is perpendicular to Z and Y and consequently horizontal. Offsets are applied in the direction of the Y-axis.

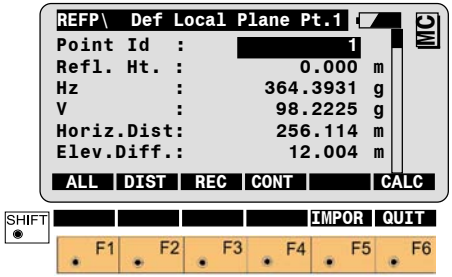


Define Points

Coordinates of the origin are entered by the user after plane definition.

The "origin" is defined as the projection of the first measured point onto the calculated (adjusted) plane.

This dialog defines the points that determine the plane. Up to 10 points can be used. They can be measured or imported from a file.



F1 Simultaneously measure and record data in the Meas job. Continue to next point.

F2 Measure a distance.

F3 Record the measurement in the measurement job.

F4 Continue to next point without recording data in measurement job.

F6 Calculate the plane parameters. Note: this key is only available after two points have been measured/input.

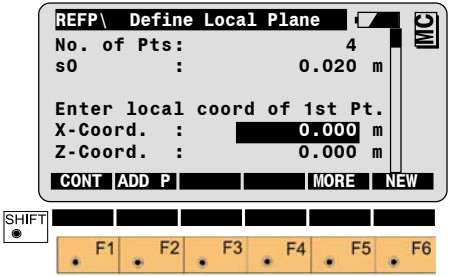
SHIFT F5 Import point coordinates.

SHIFT F6 Exit program.

Two points define a vertical plane. Use more points to define a tilted plane.

The program checks if the plane is defined in space (minimum distances between points) but does not check for optimal point distribution.

Calculates the plane parameters as well as standard deviation of the adjusted plane (for more than 3 points). Coordinate entry for origin of local system.



No. of Pts.
Number of points used for plane calculation.

s0
Standard deviation of the plane.

X-Coord
Enter local X-coord of origin. The origin is defined as the projection of the first measured point onto the calculated plane (see graphics).

Z-Coord
Enter local Z-coord. of origin. The origin is defined as the projection of the first measured point onto the calculated plane (see graphics).

F1 Set origin and continue to offset dialog.

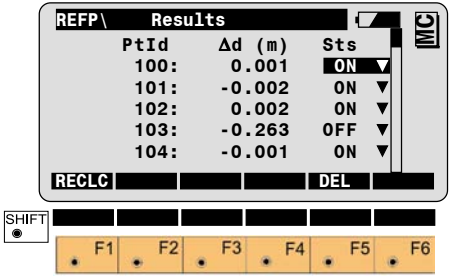
F2 Measure additional points to define plane.

F5 Show the results of each definition point. (See "Results" dialog)

F6 Define new plane.

Results Dialog

Displays the perpendicular deviation of each defining point from the plane (only if 4 or more points are used).



Pt.Id
Displays Pt.Id of defining points.

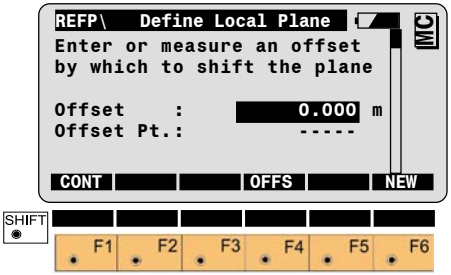
Δd (m)
Deviation of point from plane.

Sts
Point status can be ON/OFF. If point is off, it is not included in the calculation.

F1 Recalculate the plane.

F5 Delete point.

Once the plane has been defined, it can be shifted by an offset. The offset value can be entered manually or a point can be measured to shift the plane through.



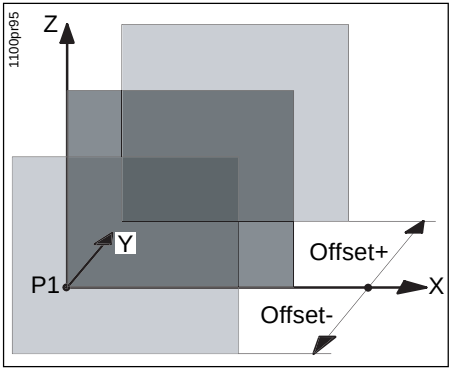
Offset
Enter value by which to offset the plane. If point was measured, calculated offset is displayed.
Offsets are applied in the direction of the Y-axis.

Offset Pt.
Displays PtId of measured point.

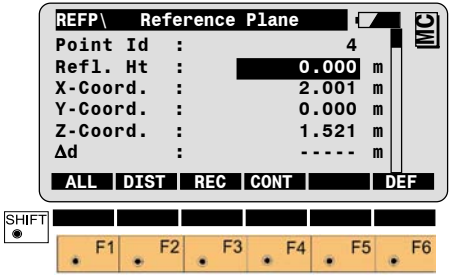
F1 Set offset and measure points on the plane.

F4 Measure point to offset plane through.

F6 Define new plane.



The local coordinate system measurement dialog displays the coordinates of points on the plane in the defined local coordinate system.



X-Coord.
X-coordinate in local system. Changes with telescope movement.

Y-Coord./Δd
Y-coordinate in local system. This is always identical to Δd - the distance to the plane and is 0.000 unless a distance was measured.

Z-Coord.
Z-coordinate in local system. Changes with telescope movement.

F1 Measure and record data in active Meas job and logfile if configured.

F2 Measure a distance.

F3 Record data in active measure job and Logfile if configured. Increment Point Id.

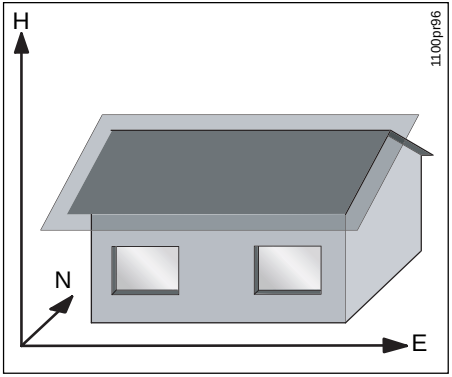
F4 Clear distance and increment PtId without recording data.

F6 Return to Define Offset dialog.

GSI file always stores instrument system information. For local system information turn Logfile ON (see chapter "Configuration").

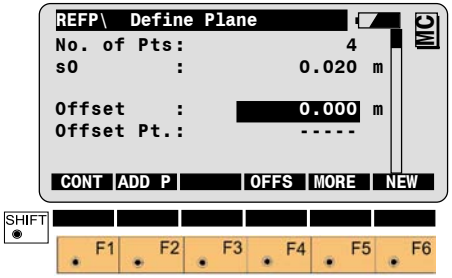
Instrument system

The "Define Point" dialogs for instrument systems are the same as for local systems. The plane coordinate system is not defined by the user. Points on the plane have instrument coordinates.



Define Instrument Plane

The “Define Plane” dialog combines standard deviation and offset.



No. of Pts
Number of points used for calculation.

s0
Standard deviation of the plane.

Offset
Enter value or measure point to offset the plane. Offsets are applied in the direction of the normal vector.

Offset Pt.
Displays PtId of measured point.

F1 Accept settings and measure points on the plane.

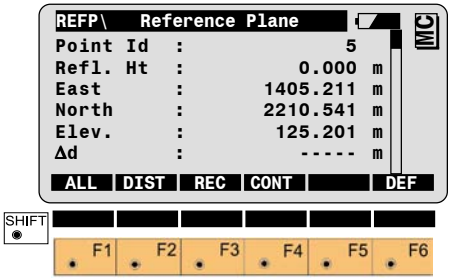
F2 Measure additional points to define plane.

F4 Measure point to offset plane through.

F5 Show the results of each definition point (see "Results" dialog).

F6 Define new plane.

The coordinates shown for the points are in the instrument coordinate system. Keys are the same as for "Local".



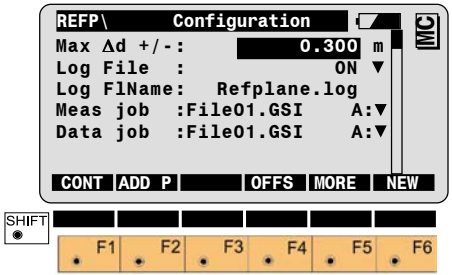
East
East coordinate of point. Changes with telescope movement.

North
North coordinate of point. Changes with telescope movement.

Elev.
Elevation of point. Changes with telescope movement.

Δd
Distance from point to plane. "-----" unless a distance was measured.

Start the "Configuration Editor" from the "Main Menu".



Max Δd
Maximum allowed perpendicular deviation of plane definition point from calculated plane.

Log File
Set to ON, the program records measurement data to a log file.

Should be **ON** for local systems, since GSI file only contains instrument coordinates. Log file saves local system coordinates.

Log FlName
Enter the Logfile name.

Meas job
Sets the measurement job to record data to.

Data job
Sets the data job containing fixpoint coordinates.

F1 Store the configuration and return to “Main Menu”.

F5 Set the values to default.

F6 Display date and version no. of running application.

If Logfile is set to ON the measurements and the results are stored in the ASCII-file specified within the "Configuration". This file is created in the directory LOG on the memory card. Subsequently, you can read out the memory card and obtain a hard copy of the Logfile.

If ON, data is always added to the specified Log-file.

The Logfile contains the following information:

Header
The header line contains the program used, information about the instrument, the name of the data file as well as date and time.

Configuration
Each modification of the reference plane is stored.

Record

For each measurement a record is stored containing:

- Points defining the plane in local or instrument coordinates, depending on settings.
- Plane parameters (standard deviation, no. of points used, offset)
- Coordinates of points measured on plane.

TPS1100 Prog. Reference Plane V 2.00
Instrument : TCRA1102plus, Serial 618268
Meas.File : MYFILE01.GSI
Progam Start : 12/11/2000 at 15:15

Define Local Plane

	Point Id	X-Coord (m)	Y-Coord (m)	Z-Coord (m)	Dd (m)	Status
Station coord	2	1.936	-3.142	1.936		
	100	-0.000	0.001	-0.000	0.001	ON
	101	3.458	-0.002	3.458	-0.002	ON
	102	3.310	0.002	3.310	0.002	ON
	103	2.222	-0.263	2.222	-0.263	OFF
	104	0.644	-0.001	0.644	-0.001	ON

No. of Pts : 4
s0 (m) : 0.000
Offset (m) : 0.000
Offset Pt. : -----

Points Measured

	Point Id	X-Coord (m)	Y-Coord (m)	Z-Coord (m)	Dd (m)
	201	0.727	0.000	0.404	-----
	202	1.835	-0.004	1.095	-0.004
	203	-0.028	-0.065	2.089	-0.065
	204	2.175	-0.290	0.170	-0.290
	205	2.519	0.000	0.908	-----

Typical logfile entries in the "Reference Plane" program.

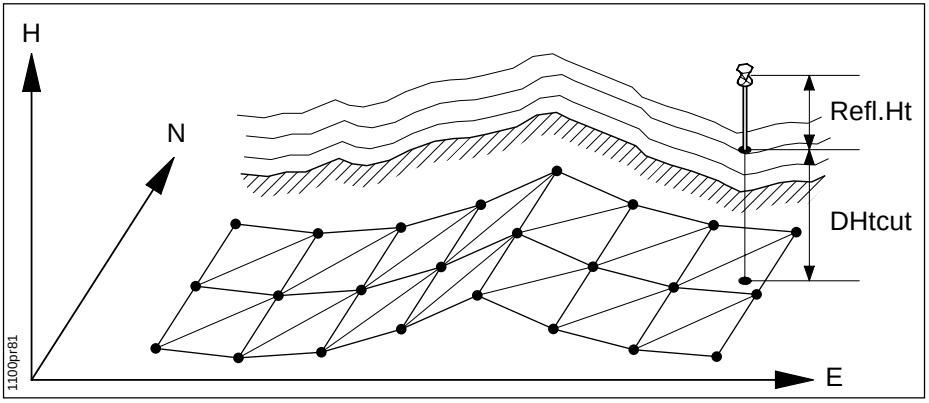
Introduction

This manual describes the "DTM-Stakeout" program for the TPS1100 Professional series instruments. The program is used to compare measured elevations to a stored Digital Terrain Model. After measurement the CUT or FILL value between existing ground and the DTM is displayed.

"DTM Stakeout" can be used to stake out points where the DTM represents the surface to be staked.

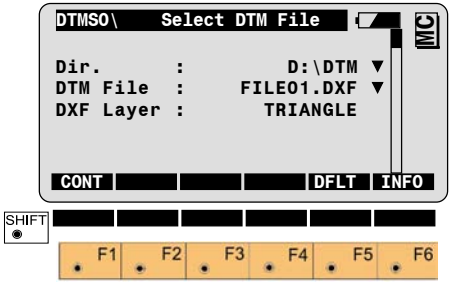
It can also be used to compare existing ground to the DTM, e.g. for quality control purposes where the DTM represents the final project surface.

"DTM Stakeout" requires the instrument station to be setup and oriented. The instrument must also be configured in the same units as those used in the DTM.



Select DTM File

The first dialog allows selection of the DTM file to be used. The file can be in AutoCad DXF format or in Leica GSI format (see chapter *Data Formats*).



Dir.
Select the directory where the DTM file is stored.

DTM File
Choose the DTM file to be used.

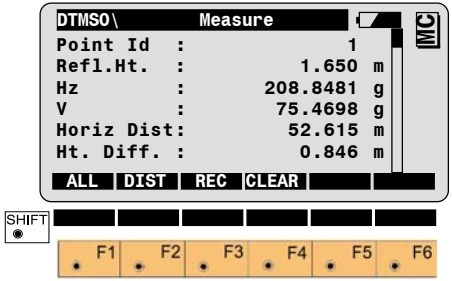
DXF Layer
If using a DFX file, enter the layer name for the DTM file.

F1 Continue to Measurement dialog. DTM-Stakeout will automatically check the validity of the file.

F5 Re-set the Layer name to TRIANGLE.

F6 Display the DTM-Stakeout information dialog.

This dialog corresponds to the TPS1100 Professional series "Measure" dialog with the additional entry of the Ht. Difference.



Ht. Diff.
Displays the difference in elevation between the DTM and the measured point.

+ (FILL): if measured point is lower than DTM.
- (CUT): measured point is higher than DTM.

F1 To measure and record the CUT/FILL values and the coordinates of the target piont.

F2 Measure a distance and calculate the CUT/FILL values.

F3 Record the measurement in the measurement job.

F4 To clear the displayed values.

SHIFT F6 Exit the program.

Data for DTM-Stakeout may be prepared in one of two formats. These are AutoCAD DXF or the standard Leica GSI format. The files must be stored on the PC-card.

Files may be named with any valid DOS name and either a *.dxf or *.gsi extension.

- **AutoCAD DXF - Format**

DTM triangles are imported as 3DFACE entities from a DXF file. Properties, Layers, etc. may be in the DXF file but are ignored by the DTM-Stakeout application. The completion of the polygon by repeating the first or last point is required by AutoCAD but not by the application. The format is as follows:

0	Start of record.
3DFACE	Record is a 3D face entity.
TRIANGLE	3D face type.
10	X coordinate, first point.
723573.984000	X value.
20	Y coordinate, first point.
7663192.178000	Y value.
30	Z coordinate, first point.
23.383000	Z value.
11	X coordinate, second point.
723576.998000	X value.
21	Y coordinate, second point.
7663191.120000	Y value.
31	Z coordinate, second point.
23.029000	Z value.
12	X coordinate, third point.
723572.684000	X value.
22	Y cordinate, third point.
7663189.966000	Y value.
32	Z coordinate, third point.
24629.000	Z value.
13	X coordinate, third point.
723572.684000	X value.
23	Y cordinate, third point.
7663189.966000	Y value.
33	Z coordinate, third point.
24629.000	Z value.
0	End of record.

- **LISCAD generated DXF File**

An AutoCAD DXF file containing 3DFACE may be generated by users of Leica's LISCAD in the following manner:

1) In Terrain Modeling/Display/ Features…Select the Model tab – Turn on only the triangles.
2) In Terrain Modeling/Display/ Groups… - Turn off all Groups but DEFAULT.
3) In CAD Output/Settings/CAD System – Choose AutoCAD DXF.
4) In CAD Output/Settings/Codes… - Deselect all the options on all the tabs.
5) In CAD Output/Settings/Models…- Set Labels to none, Contours to none, and activate the Triangles check box.
6) In CAD Output/Output! – Select the Options button – In the General tab turn off all option check boxes except Model and use Default for All, in the AutoCAD tab deselect all check boxes except 3Dimensional. Then click OK.
7) Click OK and create the DXF file that contains only the 3DFACE's.

The required format of a GSI file containing DTM triangles is described below.

Header of the DTM file

The header is the first line in the GSI file. There must be one header line per file in the follwing form:

```
41....+000JOBID 42....+DTMNTWRK 43....+DTMCOORD 44....+00001000 45....+00001000
```

WI41	Job identification, maximum 8 characters, may be defined by user.
WI42	Identification of DTM file, may not be changed by user. This entry must be +DTMNTWRK.
WI43	Identification of principal point type, may not be changed by user. This entry must be +DTMCOORD.
WI44	Optional easting offset. May be defined by user.
WI45	Optional northing offset. May be defined by user.

☞ If used, easting and northing offsets are added to the coordinates of the triangle vertices. These values have no digits to the right of the decimal place.

For example if units are set to (m), "44….+00001000" means that 1000m will be added each Easting coordinate.

The data block records for the triangle vertices are contained within the GSI file in sets of three. There is one block for each vertex of each triangle.

Data block for triangle vertex

```
11....+00000907 71....+TRI00001 81..10+21000000 82..10+50996000 83..10+00100000
```

WI11	Point identification, ignored by the application.
WI71	Triangle number, indicates triangle the coordinates belong to.
WI81	Easting of the triangle vertex.
WI82	Northing of the triangle vertex.
WI83	Elevation of the triangle vertex.

☞ The program cannot calculate the model from coordinate lists. The coordinates must be sorted by triangles. That is, three coordinate blocks with the same triangle number must be found together in the file. The vertices do not have to be sorted in any other way.

Example GSI file

The following is a portion of a DTM file in the Leica GSI format. The header and coordinates for the first four and last two triangle vertices are shown. The file contains 44 triangles.

```
41....+000JOBID 42....+DTMNTWRK 43....+DTMCOORD 44....+00001000 45....+00001000
11....+00000907 71....+TRI00001 81..10+21000000 82..10+50996000 83..10+00100000
11....+00000013 71....+TRI00001 81..10+21000000 82..10+50992500 83..10+00100000
11....+00000014 71....+TRI00001 81..10+20998059 82..10+50992756 83..10+00100000
11....+00000013 71....+TRI00002 81..10+21000000 82..10+50992500 83..10+00100000
11....+00000907 71....+TRI00002 81..10+21000000 82..10+50996000 83..10+00100000
11....+00000012 71....+TRI00002 81..10+21001941 82..10+50992756 83..10+00099500
11....+00000014 71....+TRI00003 81..10+20998059 82..10+50992756 83..10+00100000
11....+00000013 71....+TRI00003 81..10+21000000 82..10+50992500 83..10+00100000
11....+00000002 71....+TRI00003 81..10+21002859 82..10+50987867 83..10+00100374
11....+00000907 71....+TRI00004 81..10+21000000 82..10+50996000 83..10+00100000
11....+00000014 71....+TRI00004 81..10+20998059 82..10+50992756 83..10+00100000
11....+00000015 71....+TRI00004 81..10+20996250 82..10+50993505 83..10+00099600
…
11....+00000908 71....+TRI00043 81..10+20996000 82..10+51000000 83..10+00099800
11....+00000019 71....+TRI00043 81..10+20992500 82..10+51000000 83..10+00100000
11....+00000904 71....+TRI00043 81..10+20993912 82..10+51007934 83..10+00100000
11....+00000003 71....+TRI00044 81..10+21003750 82..10+51006495 83..10+00099700
11....+00000904 71....+TRI00044 81..10+20993912 82..10+51007934 83..10+00100000
11....+00000901 71....+TRI00044 81..10+21007934 82..10+51006088 83..10+00100000
```

DTM-Stakeout does not generate a logfile.

Leica Geosystems AG, Heerbrugg, Switzerland has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

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